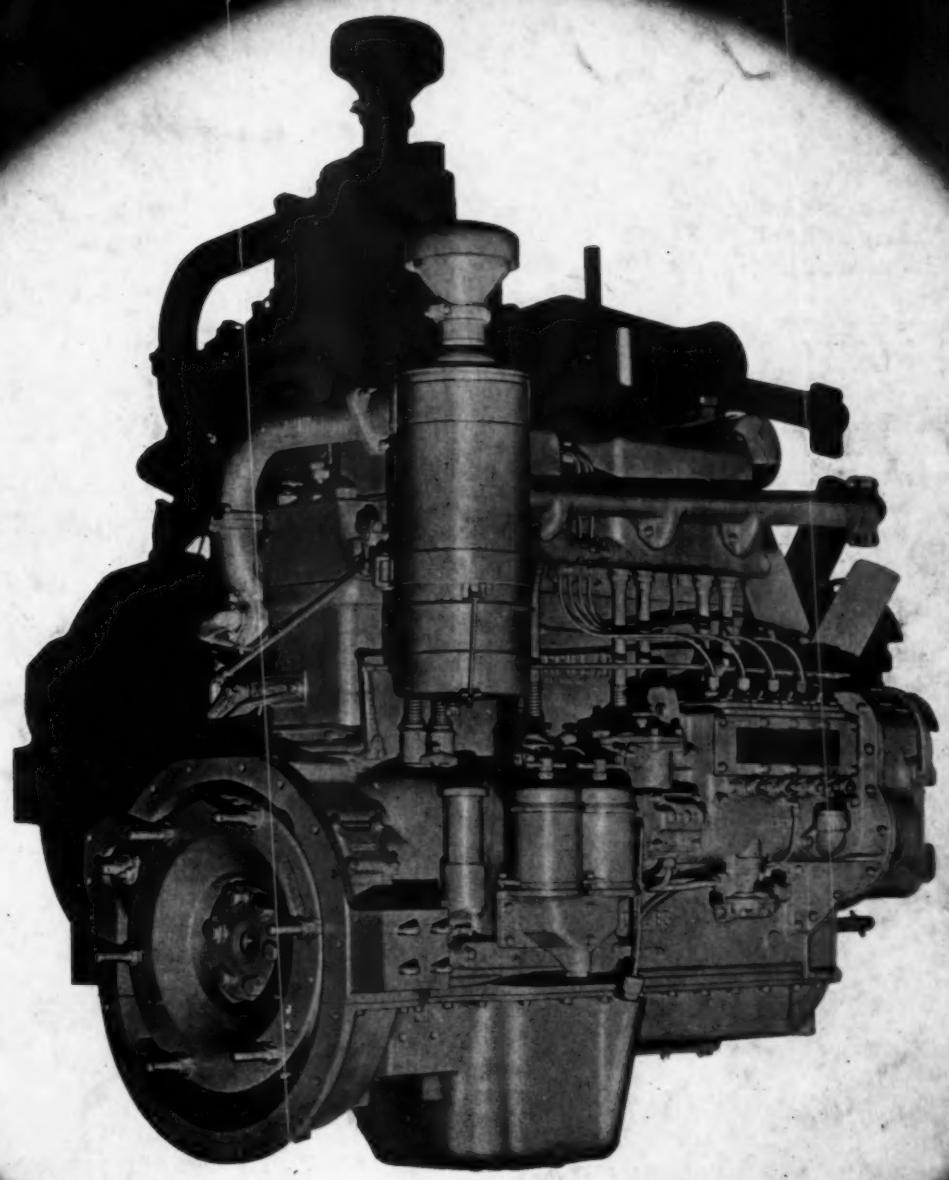
DIESEL PROGRESS

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR



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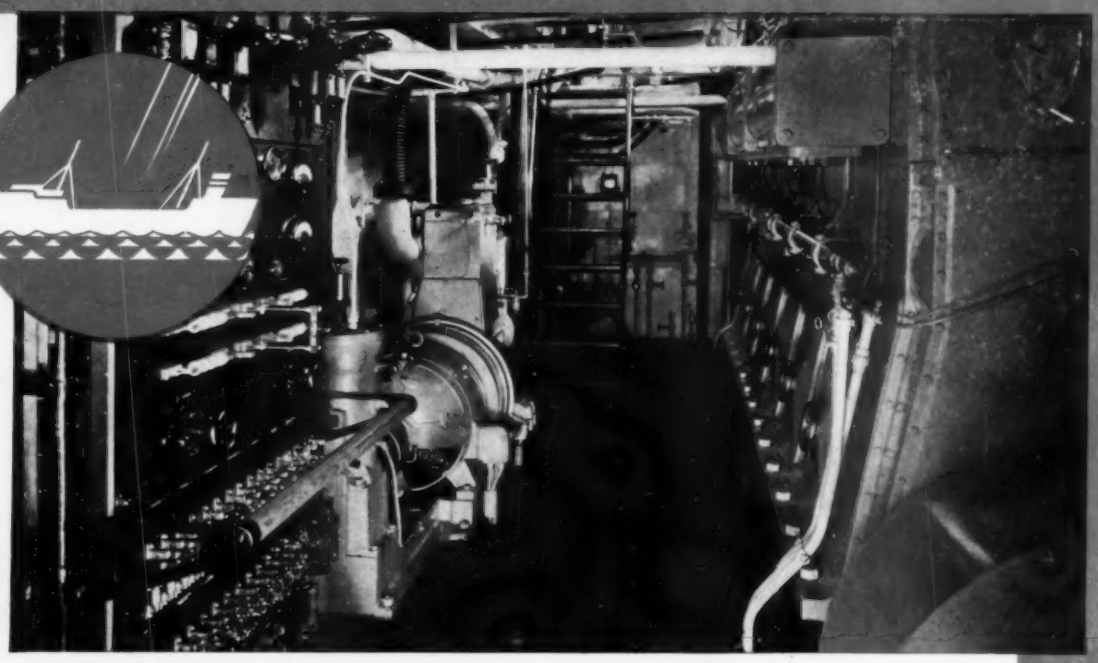
THE ULTIMATE IN DIESEL LUBRICANTS



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GULF PARVIS OILS are the result of a special refining process which produces an oil that insures minimum bearing and cylinder wear. These quality lubricants have been purified by the finest of the new selective solvent processes. They stand up over long, continuous periods of service, with outstanding economy as to oil consumption and maintenance costs.

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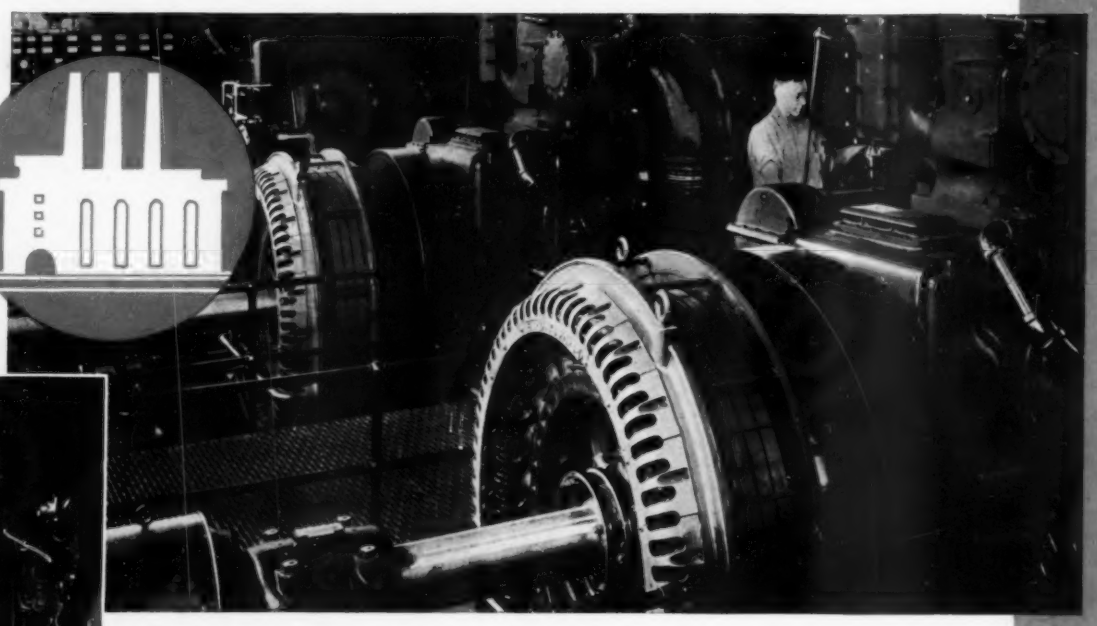
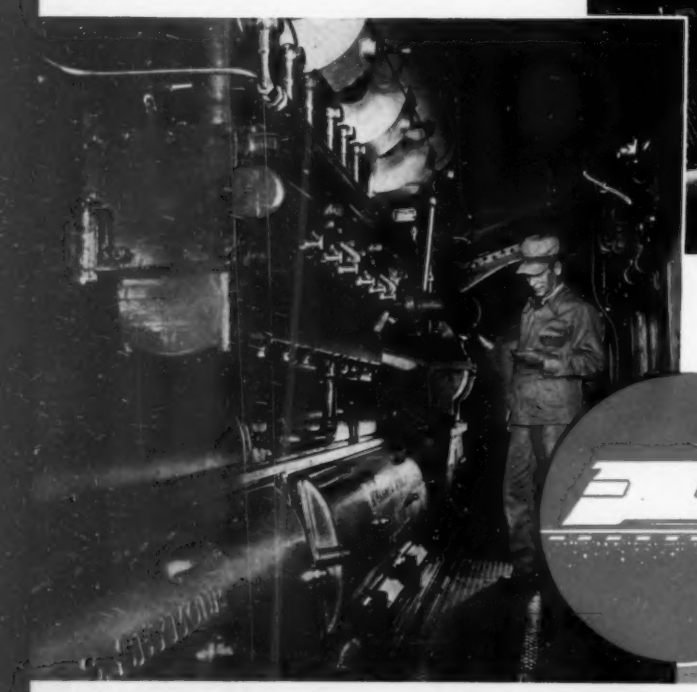
HERE IS PROOF of the quality of Gulf Parvis Oils; America's Diesel engine builders—more than 50 strong—have officially approved Gulf Diesel engine oils for the equipment they build. The use of these quality lubricants, in leading Diesel power plants throughout the country, have been an important factor in the attainment of record low costs for plant operation. *To reduce your maintenance costs* and insure continuous, trouble-free operation, use Gulf Parvis Oil.





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GULF ENGINEERS have kept pace with every phase of the development of Diesel engines. Now, streamline trains, such as the New Haven's COMET and the G. M. & N.'s REBEL depend on Gulf lubricants to keep their power plants in continuous operation, with low maintenance costs.

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PITTSBURGH, PA.

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GULF INDUSTRIAL LUBRICATION

DIESEL PROGRESS for November, 1935, Volume I, No. 7. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Subscription rates: United States and Pan American countries $3.00, Canada and all other countries $5.00 per year. Single copy price 25 cents in U. S. A., 50 cents for all other countries.

WE take a great deal of pleasure in announcing that the Secretary of the United States Navy has entrusted us with a commission to build the propelling machinery for three United States Submarines now under construction.

This welcomed commission follows a similar trust committed to us last year to build Diesel equipment for one United States Submarine.

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The Hooven, Owens, Rentschler Co.
Hamilton, Ohio

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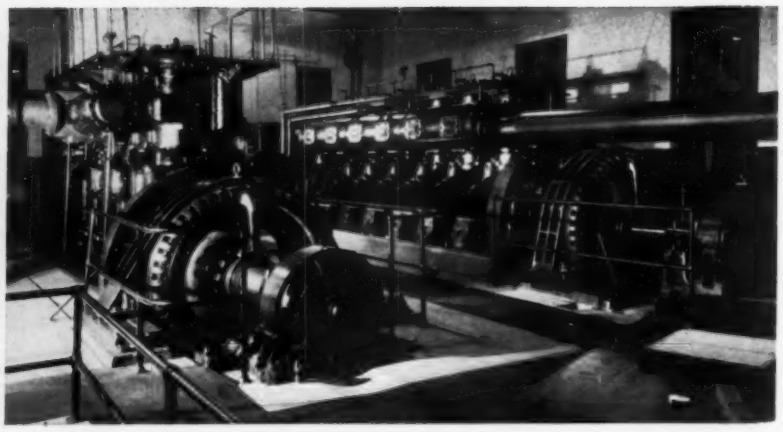


This Iowa plant is one of many which have found economical lubrication in EN-AR-CO DIESEL ENGINE OILS.

MODERN LUBRICATION FOR MODERN POWER

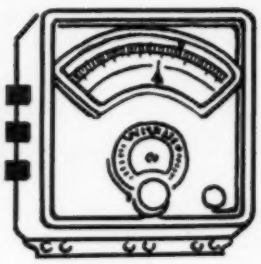
Modern power is economical power produced by engines designed to deliver greater horse power per pound of weight, per cubic foot of size and per dollar of operating cost.

EN-AR-CO DIESEL ENGINE OILS

insure continuous economical operation. En-ar-co lubricants are the result of more than half a century of experience devoted exclusively to the refining of QUALITY lubricants. They will protect your plant against standby losses, unnecessary repairs and at the same time give you an actual saving in lubricating costs.

THE NATIONAL REFINING COMPANY
HANNA BUILDING CLEVELAND, OHIO
REFINERS OF WHITE ROSE GASOLINE

AUTOMATICALLY----
you can *now* read and protect 39 different temperature points *with a single instrument!*



1. ***Exhaust***

For example, indicator for this control can be set at 800 degrees, and it will automatically check every 10 seconds each exhaust thermocouple up to 39, and in case of excess temperature will automatically sound an alarm and shut down engine if desired.

2. ***Water***

Then manually or automatically a new limit cycle can be established and controlled, which will check your water temperature one minute, and your exexhaust temperature another minute.

3. ***Lubricating Oil***

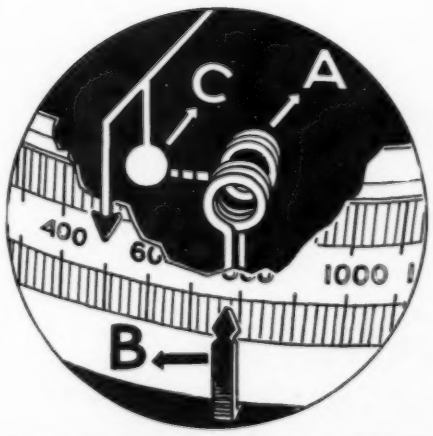
Temperature of the oil can also be read and controlled manually or automatically by setting the pointer in the cycle covered by the oil thermocouples.

A performance heretofore thought impossible of accomplishment.

Every Diesel Engine manufacturer and every Diesel Engine user will be very much interested in this, and should get the complete information on this new development of control.

Because, heretofore, you have either not had the instruments to check the performance required, or you have had to use too many instruments to be economical or practical.

The WHEELCO System of Automatic Control is a *NO CONTACT CONTROL SYSTEM.*



Here's How—

The sketch at left shows the control coil "A" which sets up an electro static field. This coil may be set at any position on the scale by moving pointer "B." When the temperature indicator carrying flag "C" enters the field "A," an electrical relay, using a mercury tube, functions to operate signal lights, alarms or engine circuit breakers.

This is a positive, dependable method of control, which eliminates all cogs, gears, cams, etc., in the control instrument.

THERMO CONTROL DEVICES, *Inc.*

1116 MILWAUKEE AVENUE CHICAGO, ILLINOIS

An ATLAS DIESEL handled the AGGREGATE

IN THE PIERS and anchorage of the Golden Gate Bridge, greatest of all the world's suspension bridges, there are more than 260,000 cubic yards of concrete. That is sufficient concrete to build a solid shaft 25 feet square and two miles high.

Practically all of the aggregate for this huge amount of concrete was furnished by Pacific Coast Aggregates, Inc., which operates 25 modern sand and gravel plants in Northern California. The aggregate for the Golden Gate Bridge came from the Livermore Valley and the picture below shows how an ATLAS DIESEL powered Brownhoist locomotive crane handled the aggregate.

The Livermore plant has a capacity of 350 tons per hour and the ATLAS DIESEL powered Brownhoist is used for switching, loading and unloading railway cars. At their Niles plant, a few miles away, is another ATLAS DIESEL powered Brownhoist, working in conjunction with a similar unit powered by steam.

The ATLAS DIESEL powered Brownhoist has an average fuel cost of $25.00 per month or about a dollar a day. The steam rig shows a fuel cost of $5.50 per day. In addition to the high fuel cost there is a further waste of time and fuel steaming up in the morning, and there are constant interruptions in having to shut down for water.

Comparative figures like these have influenced the construction industry to "go Diesel" and that means ATLAS DIESEL. There are today more ATLAS DIESELS powering shovels, excavators and draglines and locomotive cranes than the engines of all other manufacturers combined. The construction industry "dishes out" tough jobs—and Atlas Diesels can "take it".

ATLAS IMPERIAL DIESEL ENGINE CO.
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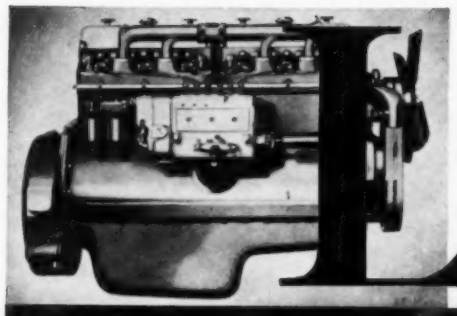
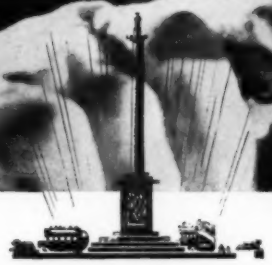
ATLAS IMPERIAL



London

USES MORE *COMET* DIESELS



TIME

the Weekly Newsmagazine

Says:

that the London Passenger Transport Board of seven, a government bureau, supreme over all London transport lines, has lately been scanning fuel costs of its 6,000 buses and coaches, 850 of which use Diesel engines. The Board announces that all future contracts will be for oil-burning Diesel equipment which it found much less expensive to operate.

In all these Diesel-equipped London coaches and buses, the big majority of the engines are of the *Comet Type*, preferred not only for its marked fuel savings, demonstrated by several years of road tests, but because of its clear exhaust, great smoothness and easy starting.

In America, this *Comet Type* Diesel is now being built exclusively by the Waukesha Motor Company. Compression ignition engine . . . 100 hp. to 140 hp. . . . just the right size for coaches, trucks and tractors, and it's rumored that the research engineers have another size ready. *Write for new Bulletin 1001. Waukesha Motor Company, Waukesha, Wisconsin.*

See the Waukesha Engine Exhibit at the Shows—Newark and New York

WAUKESHA ENGINES

THE ANSWER TO MANY A POWER PROBLEM!

The Gladys L. 70 ft. Cruiser owned by Leroy French of New York and powered with a Buda 6LDM 909 Diesel Engine.

BUDA
150 H.P. DIESEL!

THE BUDA 6LDM 909! There is no other Marine Diesel Engine like it on the market today. It brings features that are exclusively Buda—features that mean longer engine life and smoother operation.

Only 97 7/16 inches long with reduction gear it means 150 H.P. in a compact package—909 cu. in. of piston displacement and snappy power in a space impossible of occupancy by any other Diesel engine of equal displacement. This means Diesel safety can be brought to many boats now using gasoline without loss of horsepower.

Compare it on the basis of piston displacement with any other marine Diesel Engine.

Check its outstanding advantages.

—it has no equal!

May we send you a bulletin?

Ask for Bulletin 844

THE BUDA COMPANY

Marine Engine Division K

Harvey [CHICAGO SUBURB] Illinois

BUDA MARINE ENGINES

OUTSTANDING FEATURES

- Quicker Smoother operation due to low maximum pressures.
- Long life operation due to low pressure rise.
- Lower compression ratio—comparable to that of gasoline engines.
- Low injection pressures.
- No flame striking the pistons or cylinder walls.
- Large orifice in nozzles makes them non-clogging.
- Easy starting.

Ask for details on this Engine.

Other Diesel Engines in Sizes
32 to 180 H.P.
with or without reduction gear
Gasoline Engines
22 to 125 H.P. with or without reduction gear.

A Typical Order of Goulds Hydroils Passing Inspection

The Stamp of Approval placed on all products bearing the Goulds name testifies to quality materials, precise manufacturing methods and rigid inspection.

This is reflected in the Stamp of Approval placed on Goulds Hydroil Oil Purifiers by its purchasers. Repeat orders from the government, utilities, municipalities, oil companies, marine companies, etc., testify to the satisfactory service rendered under all types of operating conditions—no matter how severe.

It verifies the savings that Goulds Hydroils make—Savings on engine parts and repairs—Savings in lubricating oil and operating expense. It places the stamp of approval on non-stop Diesel performance that Hydroils make possible.

It is your guarantee of the finest Centrifugal Oil Purifier money can buy.

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GOULDS PUMPS Inc.

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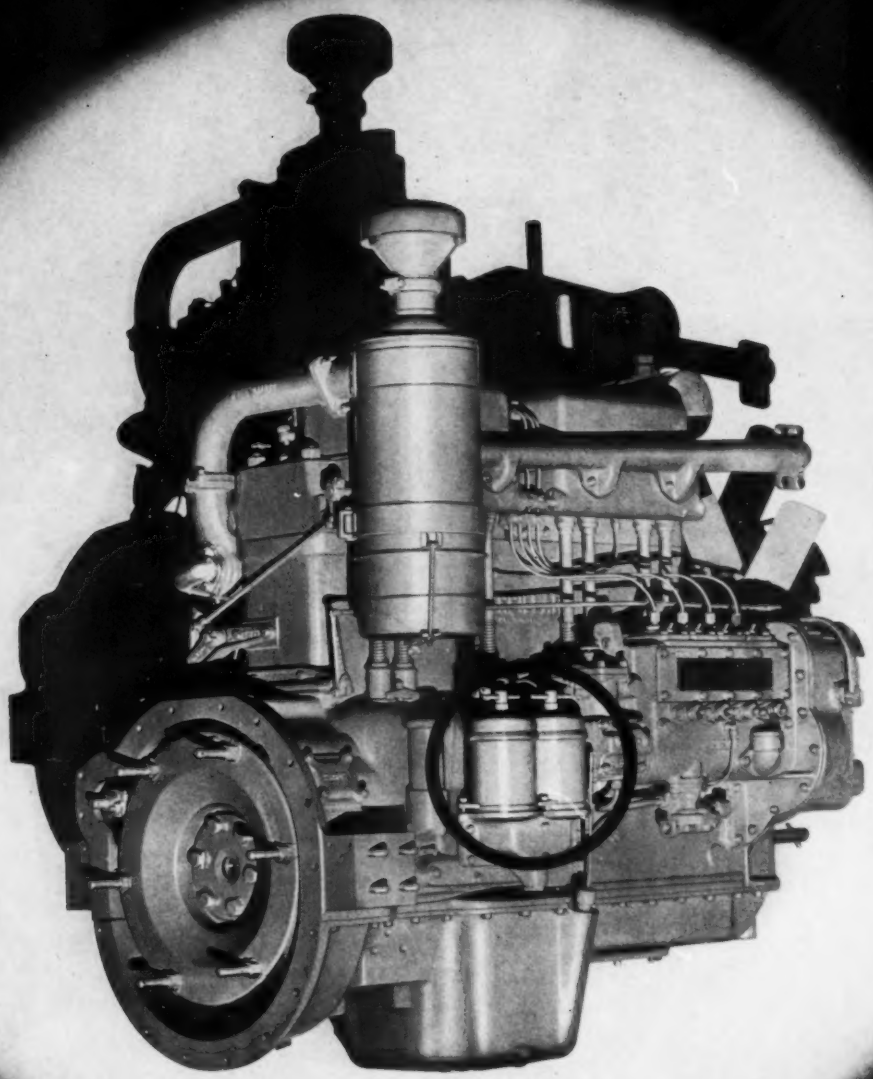
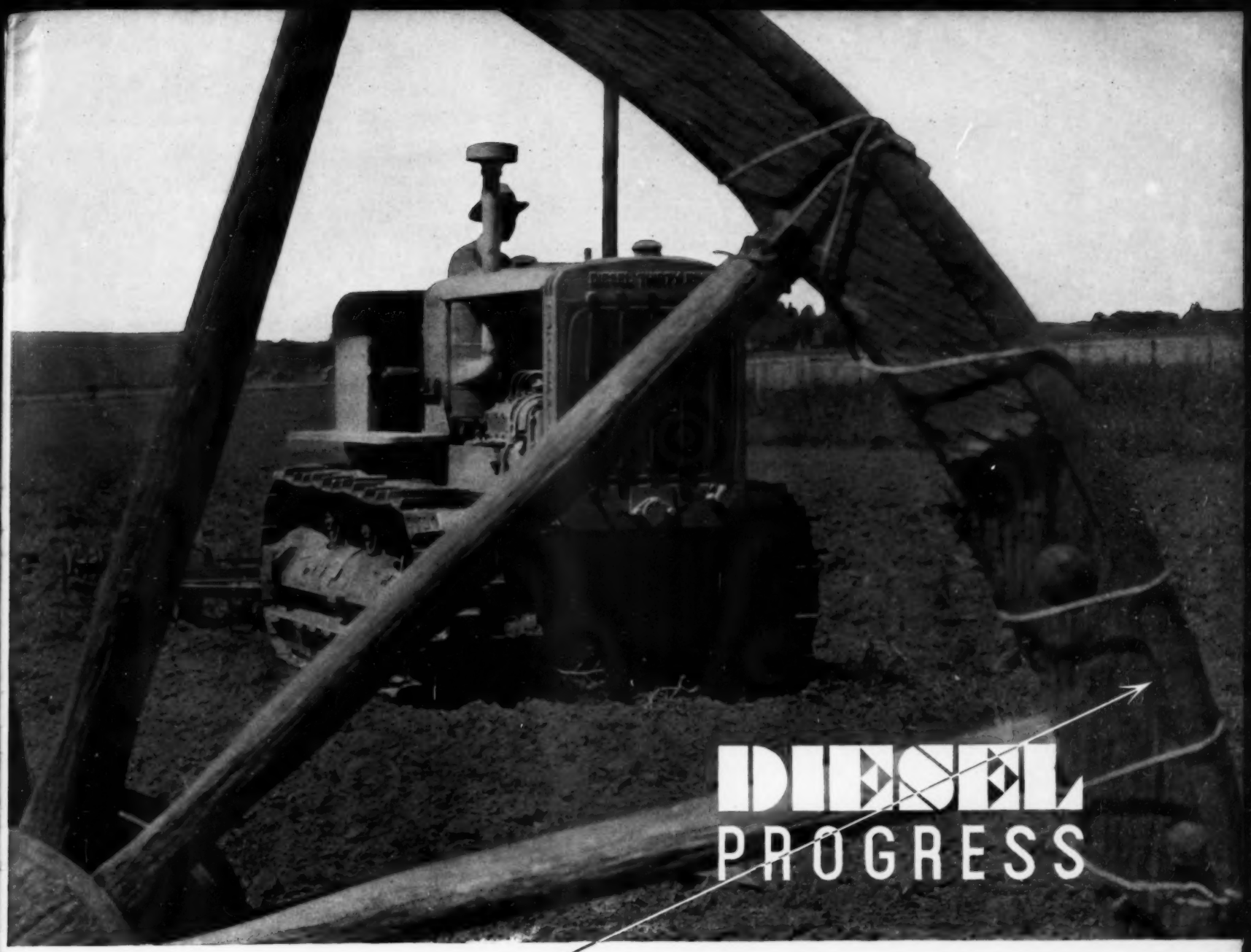


"THERE'S A REASON"

Caterpillar, outstanding producer of Diesel Power, relies on the Purolator Oil Filter, for their protection of both fuel and lube oil. We invite contacts with every character of Diesel unit that may require the same reliable, dependable service. Motor Improvements, Inc., Newark, N. J. Makers of

PUROLATOR

The Oil Filter



NOVEMBER CONTENTS

	PAGE
U. S. PIPE-LINE DREDGE, *PULLEN*	10
GERMANY'S NEW ZEPPELIN	12
WHEELER'S 1936 DIESEL CRUISERS	14
THE AUBURN DIESEL AUTOMOBILE	16
THE *MARK TWAIN* ZEPHYR	17
OIL FIELD DRILLING	20
HARRISONVILLE, MO.	22
MARMON-HERRINGTON TRUCK	25
HANNON ICE PLANT	26
U. S. NAVY SUBMARINE ORDER	29
DIESEL COMPRESSORS	30

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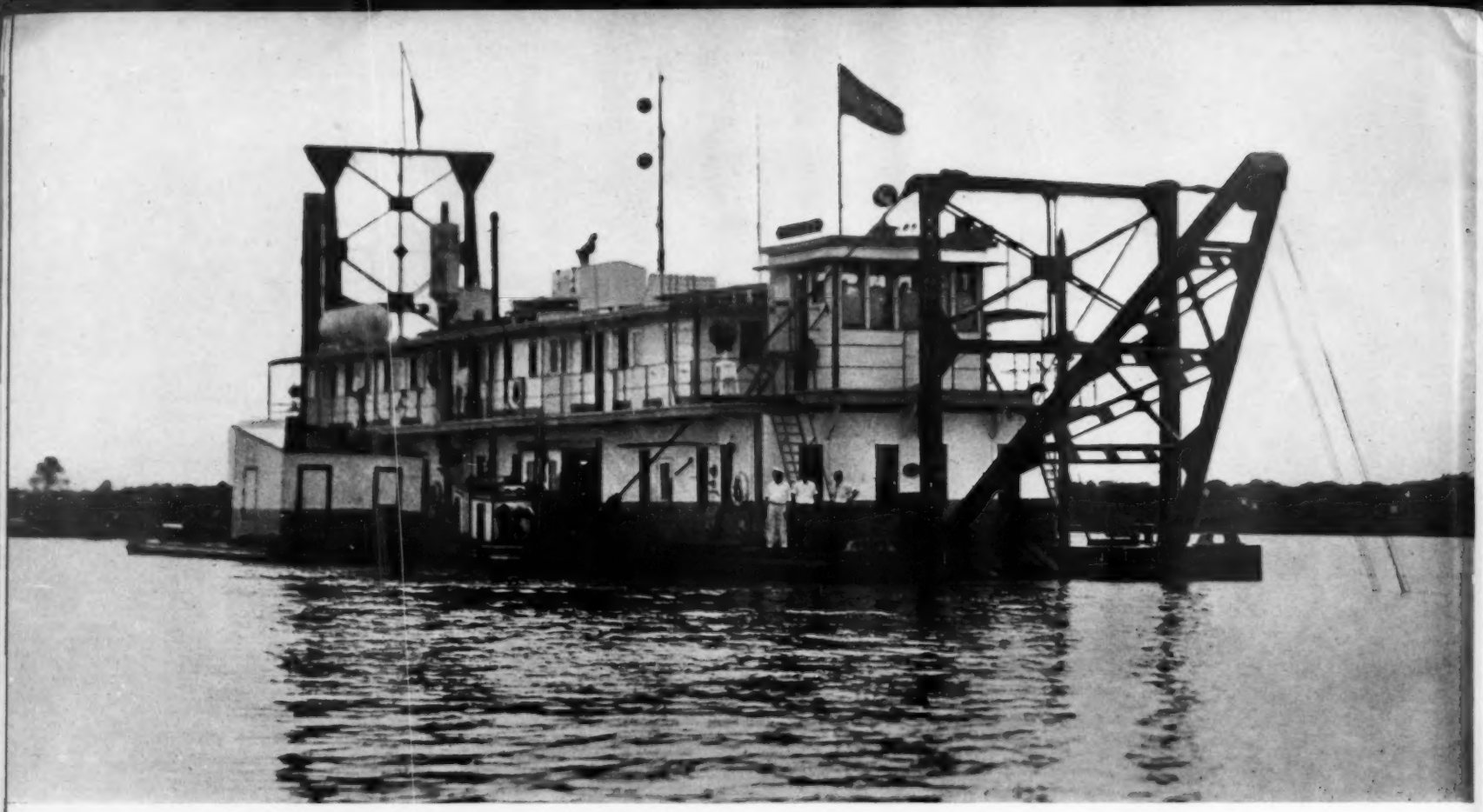


The U. S. pipe-line dredge "Pullen." The ladder (V-shaped boom, submerged on right) lowers to digging depth on bottom (maximum depth 40 feet). Through the ladder is a shaft actuating a rotary cutter that agitates the material, which then is drawn aboard the dredge through the suction pipe in the ladder. The pump then forces it through the floating pipe-line and the shore pipe-line to spoil area.

RE-POWERING THE U. S. DREDGE "PULLEN"

By R. W. KINGSBURY, M.E.

WHEN the U. S. pipe-line dredge *Pullen* was completed in 1926 she was powered with an eight-cylinder Winton Diesel which developed 500 hp. at 250 rpm., used for operating the dredging pump. An auxiliary Winton Diesel of six cylinders, developing 225 hp. at 350 rpm., direct connected to a 150 kw. generator, was used to furnish electricity for lighting the dredge and operating the auxiliary machinery. In connection with the auxiliary machinery a 20 kw. Fairbanks-Morse generating set was installed as a standby unit for lighting the dredge and for minor tasks over the weekend. On its completion the dredge was assigned to the Norfolk, Va., U. S. Engineers District for the principal maintenance work on various river and harbor projects until 1930, when it was transferred to the Jacksonville, Fla., District, being towed there from Norfolk.

The *Pullen* was constructed in 1926 by the American Brown-Boveri Electric Corporation, Camden, N. J. Steel hulled, it is a non-propelled oil engine dredge, 130 feet long, 33 foot beam, and 6-foot draft, with a displacement of 600 tons. The ladder is 61½ feet long and constructed of "I" beams and castings, all connections being bolted. The dredge has an 18-inch suction and a 15-inch discharge, and is capable of digging from flotation to a depth of 40 feet. It has a maximum swing of 300 feet. Cast steel spud anchors 60 feet long, 27 inches in diameter, and weighing approximately 19 tons are used. A basket-type cutter is employed to agitate the material, for which a 100 hp. cutter motor with a ratio gearing of 1 to 18 is used. To operate the dredge requires a crew of 57 men.

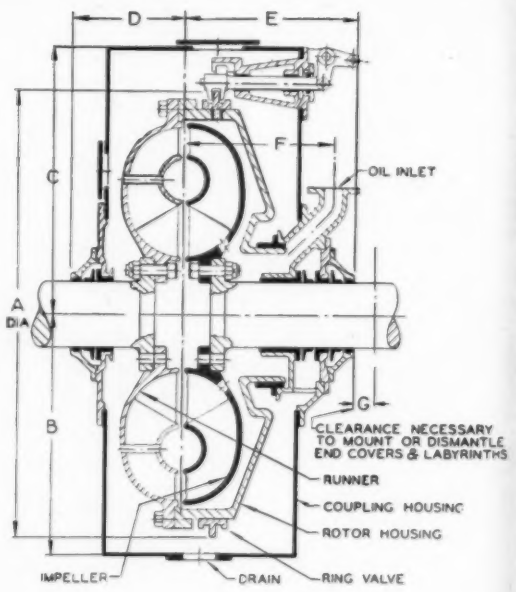


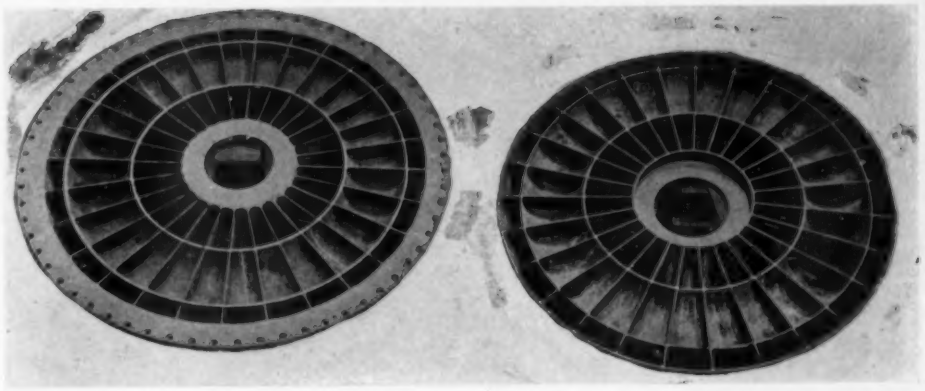
FIG. 1

In June 1930, it began dredging operations on the Intracoastal Waterway between Jacksonville and Miami. Here it continued in service until 1933, when it was towed back to Jacksonville on completion of the job, and laid up for want of work. Later that year, when the transference of another dredge, the *Welatka*, which had been engaged in maintenance work on the St. Johns river nearby, called for one to replace it, it was decided to use the *Pullen*.

After being assigned to this job it soon became apparent that in order to continue to operate the dredge efficiently and economically it would be necessary to re-power and modernize it. Proposals were issued and bids invited for engines of larger horsepower. The Winton Engine Corporation, being the low bidder, received the contract for furnishing and delivering one 8-cylinder, 850 hp. marine Diesel engine fitted with Vulcan hydraulic coupling, Kingsbury thrust bearing, Vortex exhaust muffler, oil cooler, starting-air tanks, Purolator lubricating oil filter and pyrometer. At the same time the Fairbanks-Morse Company was awarded the contract to furnish and deliver one 200 kw. generator driven by a 300 hp. opposed piston type Diesel engine with all accessories and necessary electrical equipment.

Last July the *Pullen* was towed to the shipyard where the new main engine was installed and the dredge modernized. In the process of overhauling, the 225 hp. auxiliary Winton Diesel used to operate the generator, was converted from an air injection model to a solid injection engine. The conversion, made under the direct supervision of factory representatives of the Winton Engine Corporation, proved satisfactory in every way. On August 12th, after completion of the changes, the *Pullen* was placed in service again and resumed dredging operations with its new equipment on the lower St. Johns River. The output of the dredge was materially increased with the addition of more pipe-line. With the old equipment, the maximum length of pipe-line the dredge could operate efficiently with, was 2,500 feet. Today the dredge is operating with a 5,000-foot pipe-line with its dredging efficiency at a much higher level than was previously possible with the 2,500-foot line.

One of the most interesting features of the modernization, however, is the hydraulic coupling installed between the engine and the dredging pump which prevents the transmission of torsional vibrations and shocks. It permits rapid clutching and de-clutching.



The runner **FIG. 2** *The impeller*

The coupling, which is of welded steel construction, is designed to transmit 850 hp. at an engine speed of 250 rpm. with a "slip," or difference in speed between the driving and driven shafts, of three per cent. A straight mineral oil having a viscosity of 180 to 200 Saybolt seconds at 130 degrees F. is used as the driving fluid.

A cross section of a typical dredge coupling is shown on the diagram marked Figure 1, and the impeller and runner, which make up the main rotating parts are shown in Figure 2. The *Pullen* coupling with the upper part of

. . . . *And now please turn to page 32*

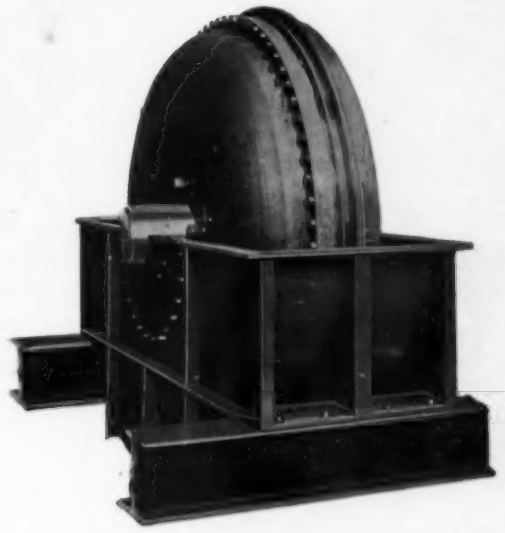
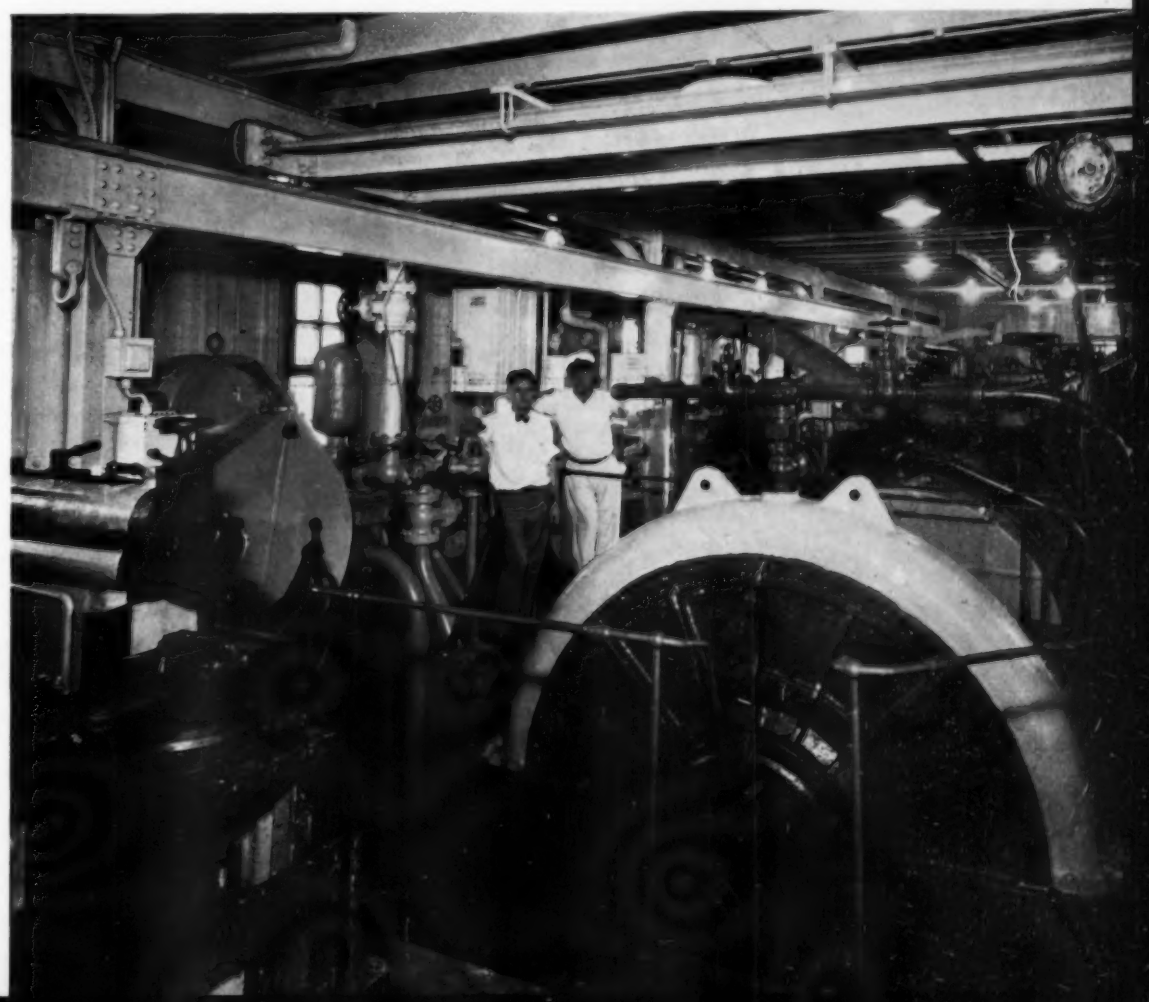
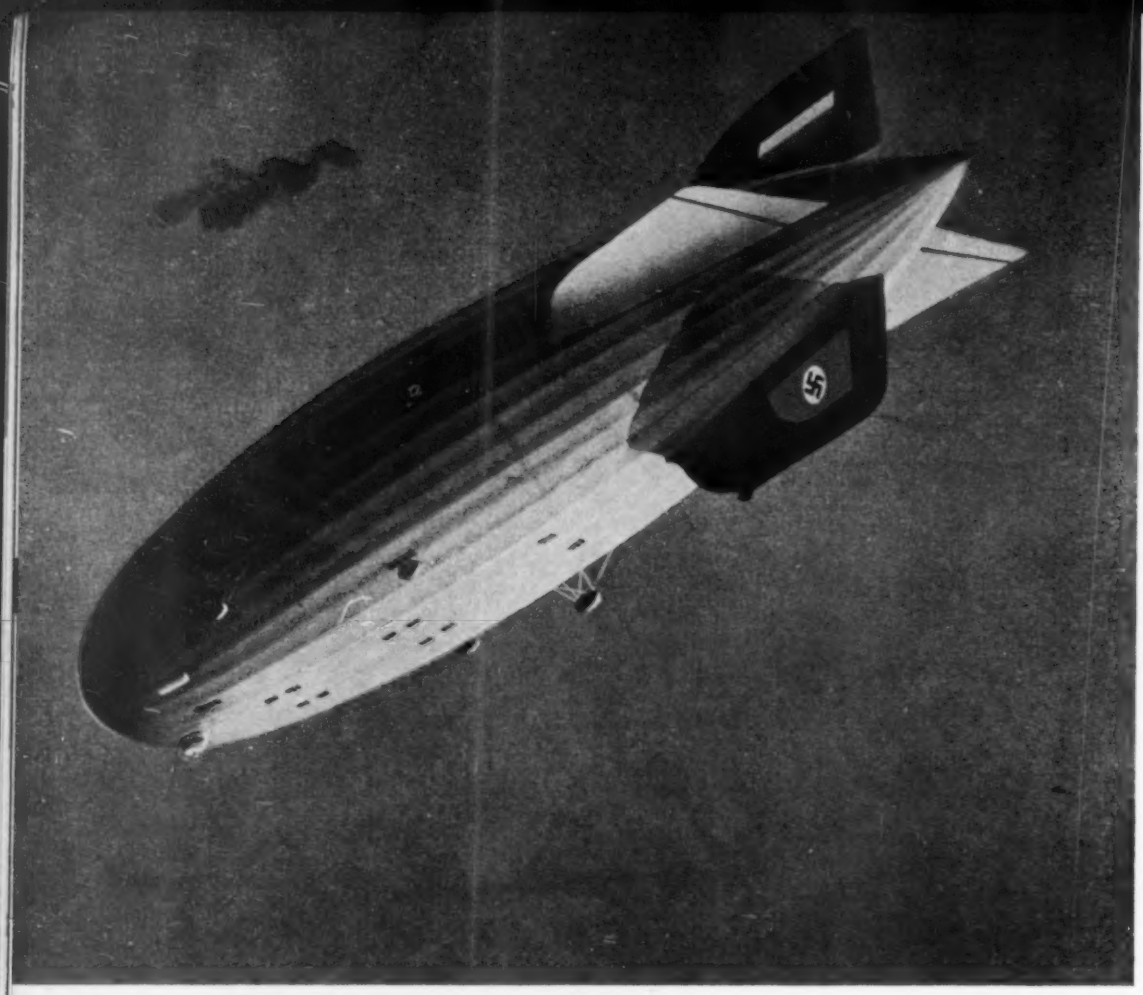


FIG. 3
The hydraulic coupling with upper half of housing removed.



The engine room of the "Pullen," showing the pump in the foreground, back of it the hydraulic coupling and, in the rear, the 850 hp. Winton Diesel engine.



The newest Zeppelin, LZ-129 as she will look on her trial flights this month. Four 1100 hp. Diesel motors will speed this giant of the skies across the Atlantic in two days. Right — the skeleton framework in the early stages of construction. Bottom — the promenade deck.

GERMANY'S NEW DIESEL ZEPPELIN

By

PAUL H. WILKINSON

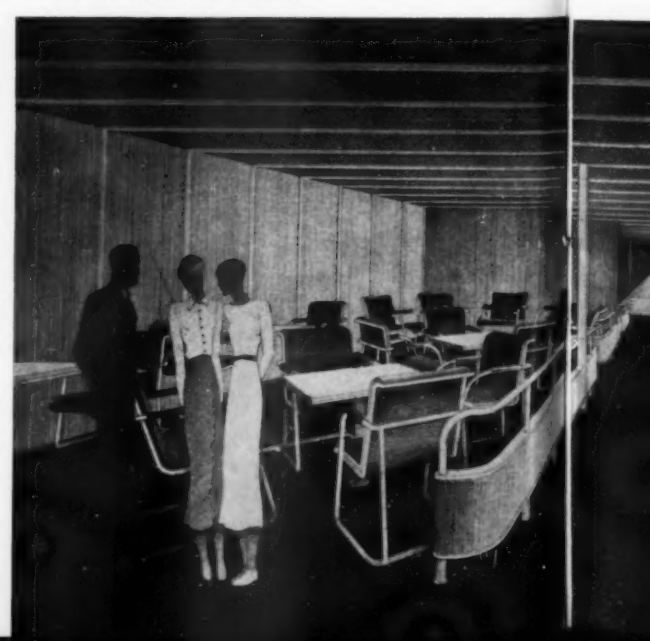
ANOTHER new form of transportation has been Dieselized. The new Zeppelin LZ-129, now known as the *Hindenburg*, has been equipped throughout with Diesel engines, and will soon be making its regular trips across the South Atlantic to South America. Two more ships are soon to be built, and they, too, will be Diesel-equipped. And if the United States should again decide to build these large airships, it can be assumed as a foregone conclusion that they will use this advanced type of motive power.

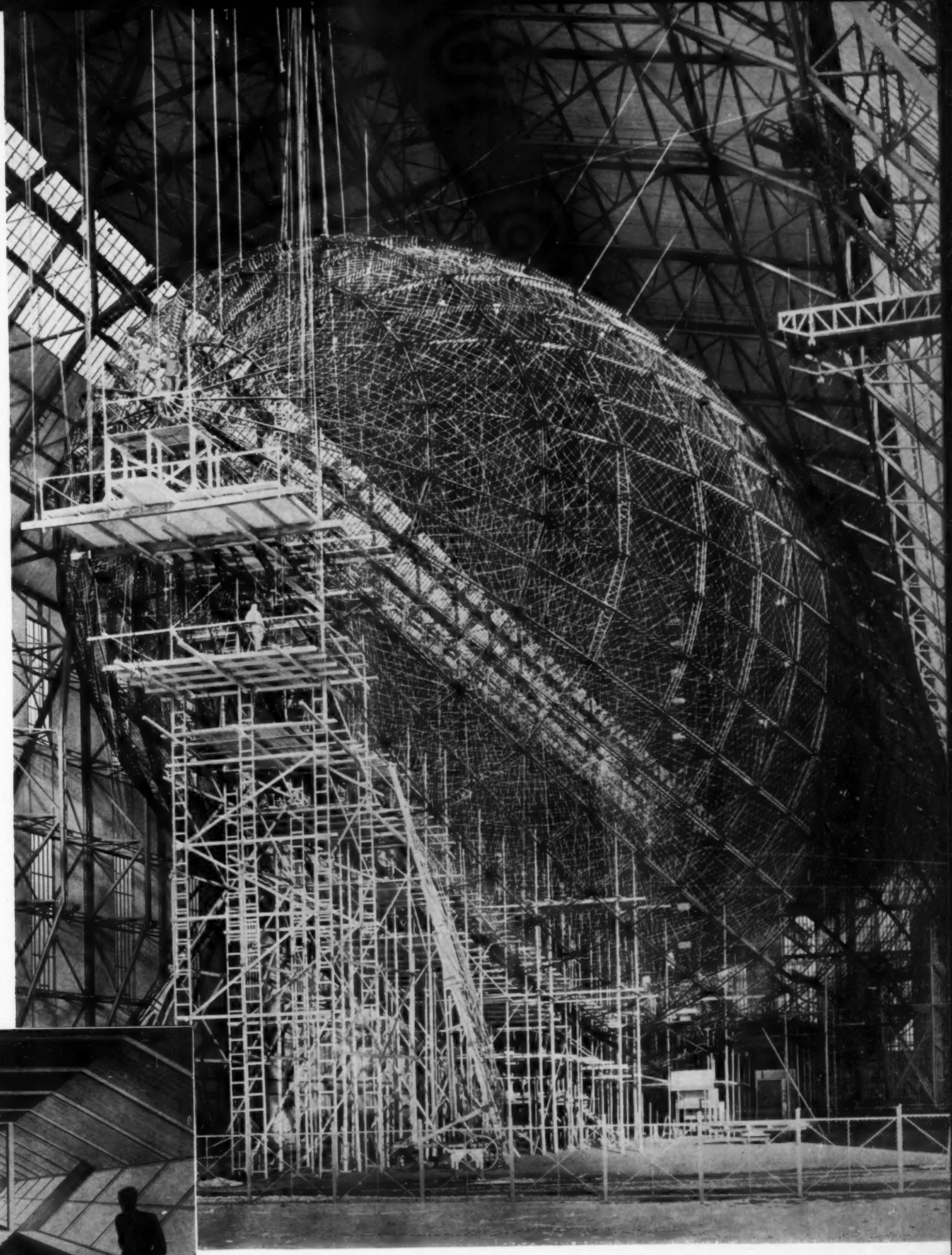
The *Hindenburg* is indeed a giant of the air. Its length is 813 ft., its height is 147 ft., and its greatest diameter is 135 ft., giving the airship a volumetric capacity of 6,710,000 cu. ft. The hydrogen, which provides the lifting power, and which may later be changed to helium, is contained in 16 gas bags inside the duralumin framework. Complicated though it may look, this framework is tremendously strong, being braced with steel wire cables, while the stern has special reinforcements to withstand any strains which may be imposed on the airship in flight.

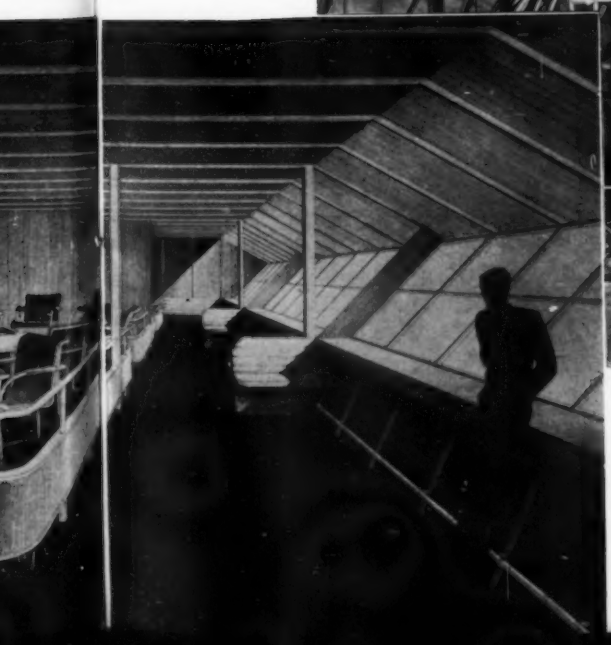
The advantages of the Diesel engine for airship use are particularly noticeable in this new field. Reduced fire hazards will greatly add to the confidence and enjoyment of the fifty passengers to be carried by this express airliner non-stop from Germany to South America. Large new hangars are being built at each end of the line, at Rio de Janeiro and Frankfort-on-Main, where the engines can be regularly inspected and serviced. Lower fuel costs and lower fuel consumption will permit lower rates and greater payloads — two most important items for the successful operation of any airline.

The motive power is furnished by four Mercedes-Benz LOF-6 Diesel engines, made by Daimler-Benz, which are rated at 1,100 hp., and weigh 4,320 lbs., or 3.93 lbs. per hp. They are of new design, with the patented Daimler-Benz pre-combustion chamber, and at the present time are the largest aircraft engines in the world, having a displacement of 5,401 cubic inches. They are also unique in that they have sixteen cylinders arranged in two banks of eight cylinders, and are of the 4-cycle type, with water cooling and water recovery system. The auxiliary engines of the *Hindenburg* are also Diesels made by Daimler-Benz, so it can truthfully be said that here is 100 per cent Dieselization!

PROF. F. A. BREHAUS, BERLIN







TOMORROW'S CRUISERS TODAY

By FRANK M. PRENDERGAST

WHATEVER ideas yachtsmen in general may have previously held about small Diesels the time has finally arrived when they must revise their ideas and bring them up to date. Facts on which they can base their judgment are now available. No better or more tangible evidence of the progress that Diesels have been making in the yachting field can be cited than the experiences of some of the leading builders of stock craft this season.

Reports that yachtsmen hear nowadays seem a little bit too good to be true. Yet the truth is, the small marine Diesel has only begun to hit its stride. Early this year one well-known naval architect who has designed scores of successful small cruising craft predicted that in ten years gasoline engines in cruising craft would be almost a curiosity.

It must be apparent to any thinking person that the number of yacht explosions, which have been all too numerous this season, has served to focus more attention on the factor of safety. The fact that, with the exercise of reasonable care on the part of owners yacht explosions are preventable, doesn't seem to alter the situation any or decrease their growing frequency.

Seeing the handwriting on the wall — to wit, that until motorboating is made still safer, sales quotas will continue to fall short of their marks — it isn't surprising now to find farsighted boat builders alert to the advantages modern Diesels offer, and anxious to give the public what it needs. Tradition dies hard among the older yachtsmen but the new buyers coming into the market have no inculcated prejudices against Diesels. These are the people who will buy Diesel craft. The parade has already started.

Diesel engine designers have proved that small, high-speed engines can be built that are light in weight per horsepower, compact in size and overall dimensions, smooth in operation, practically odorless, oil-tight, easy-starting, automatic and simple to run. The rest is a selling job and presents no insurmountable problems.

"Yes," agrees Wesley Wheeler, designer, of the Wheeler Shipyard, Inc., of Brooklyn, New York, "we feel confident that Diesels are the coming thing in this business. Otherwise we wouldn't be investing our money in them. The improvements in Diesels lately are going to make them more popular than ever."

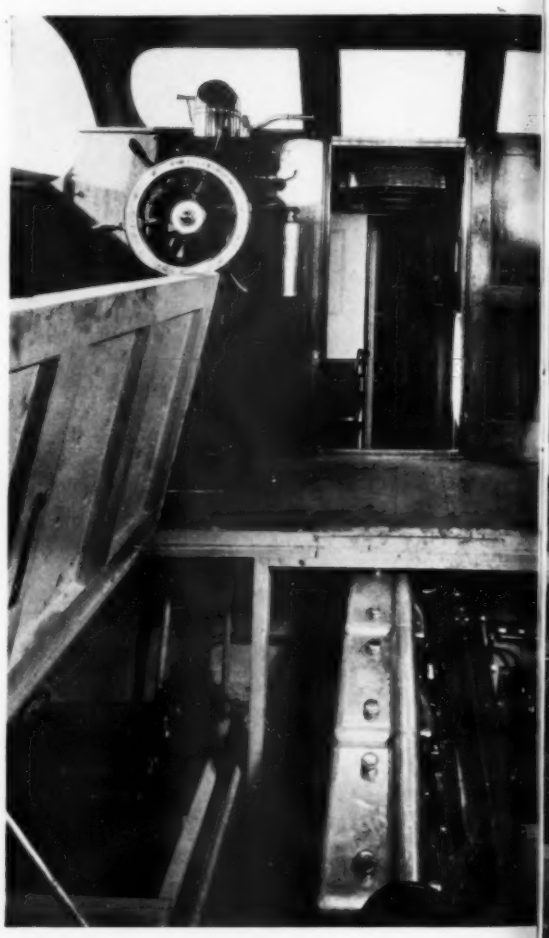
The Wheeler Shipyard is one of the largest builders of stock boats in the United States. It was one of the pioneers in developing standardized Diesel cruising craft. For five years now it has been producing Diesel cruisers from 35 feet and upward, and several of their craft are now in use by their original owners, giving them splendid satisfaction.

Wheeler's latest model is a 39-foot double cabin cruiser powered with a single, six-cylinder, 4½″ x 5¾″ Superior Diesel manufactured by the Otto Engine Works of Philadelphia (the same engine as described in the September issue of DIESEL PROGRESS) developing 100 hp. at 1,600 rpm. Turning a 23″ x 28″ propeller through a 2 to 1 reduction gear this motor drives the craft 14 miles an hour at top speed and gives a cruising speed of 12 mph. at 1,400 rpm.

With a fuel tank capacity of 175 gallons the 39-footer illustrated has a cruising radius of 550 miles — unusual for a boat of this type. On its trial trip from New York to Washington, D. C., where it was on display during the President's Cup regatta, and back to Newark, N. J., it consumed only 400 gallons of fuel for the 1,100 miles of distance logged. Wheeler estimates fuel and lubricating oil costs at 2 and 1/3 cents per mile.

As this is written the new 39-footer, after another shakedown cruise from Baltimore to Newark via the outside route, in which it covered the distance of 360 miles in 31 hours flat, is going on a demonstration trip to Philadelphia and return, and afterwards to Bridgeport and Providence.

Another cruiser, 45 feet long, to be powered with two of the above described 100 hp. Superior Diesels, is now under construction, and is scheduled to be completed in time to leave during the last two weeks of November for a demonstration trip to Miami, Fla., where



it will be on display at the Royal Palm Yacht Basin, available for inspection.

Wheeler will offer an entire line of stock Diesel cruisers for 1936 available in several sizes from 35 to 65 feet.

The Wheeler Shipyard uses Diesels not only in the craft they build, but also to generate their own electricity. Their power plant, installed last July, consists of two Wolverine Diesels, one a four-cylinder, 150 hp. unit at 400 rpm., driving a 100 kw. Ideal flywheel type gener-

The 1936 Wheeler double cabin 39-footer. At the left is a glimpse of the 100 hp. 4½" x 5¾" six-cylinder Superior Diesel which gives the craft a top speed of 14 mph. and a cruising speed of 12. Below –An interior view from aft.

ator direct connected, and with "V" belt driven exciter; and the other a 37½ hp. single cylinder unit with a "V" belt driven generator of 25 kw. capacity for carrying the night load. This plant produces electricity at the rate of ⅞ cents per kw. as closely as the Wheeler yard is able to figure it at present – a rate much lower than the yard formerly paid the local power company.

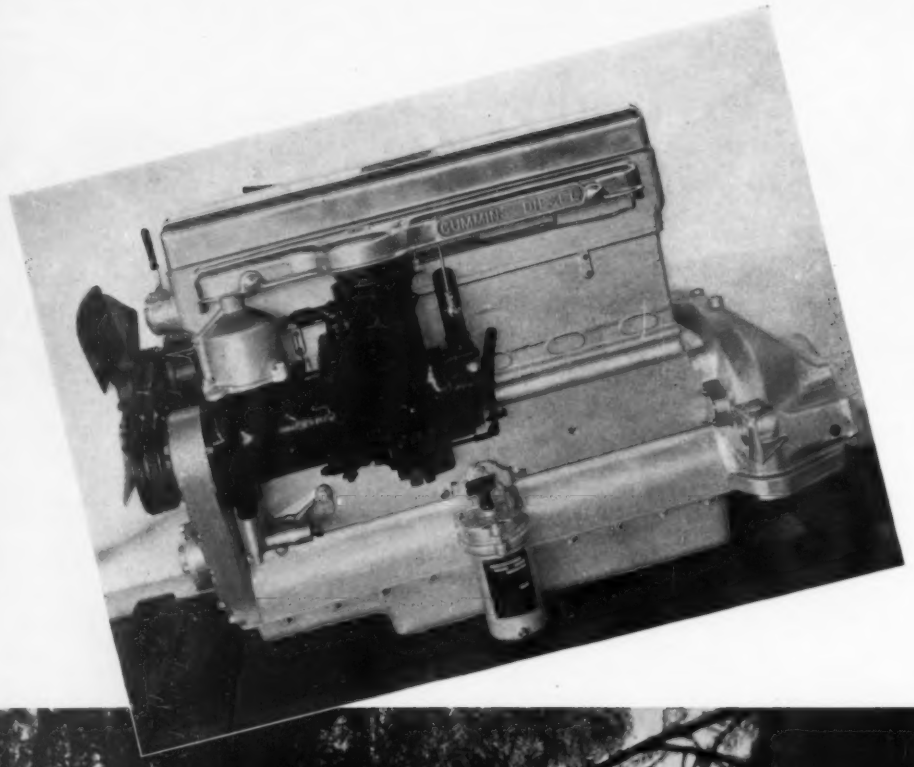
"Diesels are the coming engines for cruisers," declares Wesley Wheeler. "We look forward to seeing a tremendous amount of re-powering of gasoline engined craft within the next ten years. It's just got to come."

Naval architects, boat dealers and engine manufacturers, as well as the builders, are all aware of the distinct trend to Diesels for smaller cruising craft in the last two seasons. A recent questionnaire sent to 100 people in this group, proves that inquiries on the part of boat buyers are steadily increasing.

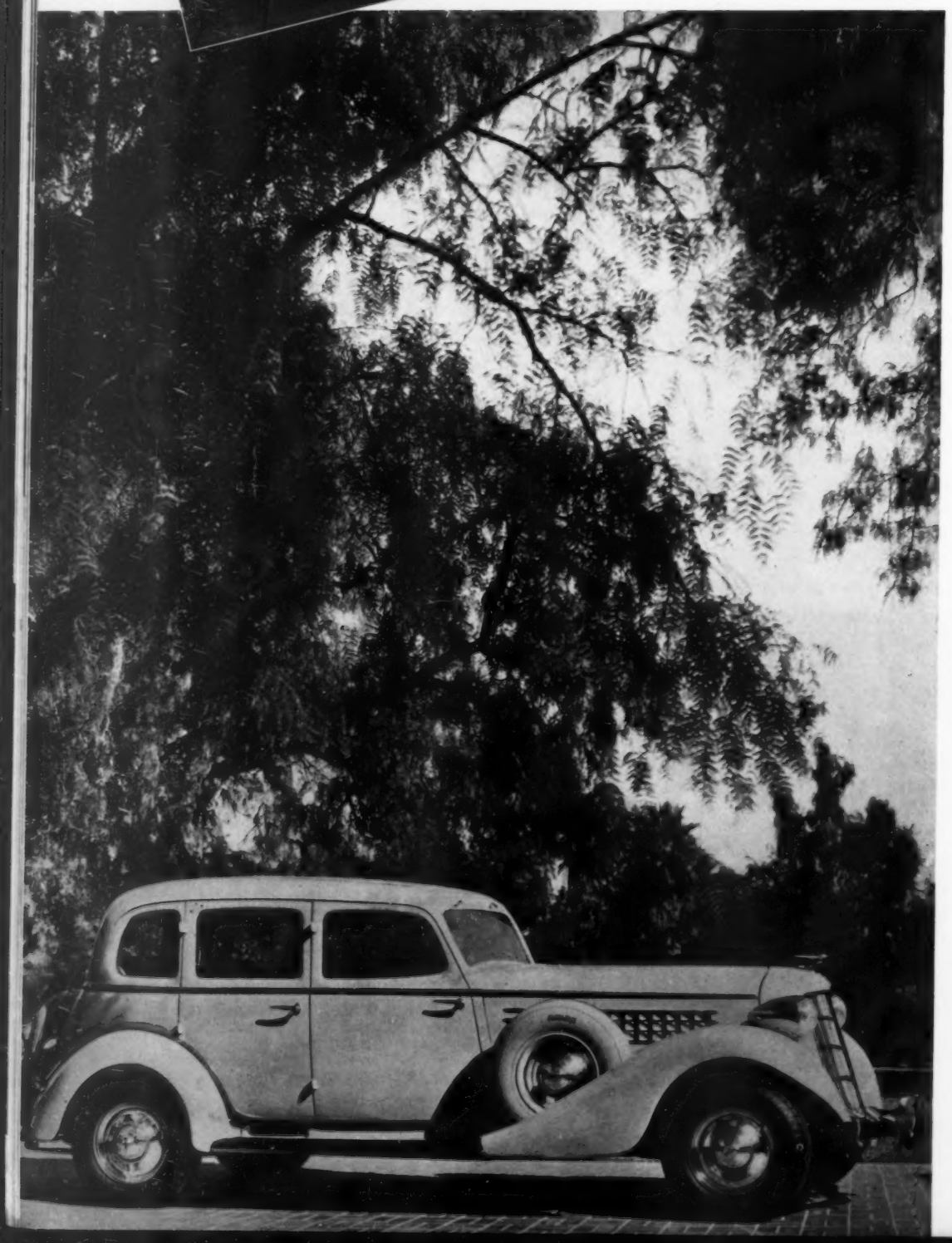
Engine manufacturers who have built both gasoline and Diesel marine engines in the smaller sizes admit that the maintenance cost of a Diesel is only about 75 per cent of a gasoline engine of the same horsepower, apart from the fuel savings.

In so far as the boat owner himself is concerned, the average well-equipped yard is fully able to install and service Diesels today, and Diesel fuel is readily available at practically all boating centers where there is any demand. The large refining companies have kept apace of the Diesel trend and have not been backward in the development of suitable fuels, and Diesel lubricants, too.

Early reports indicate that small Diesel cruisers will be more in evidence at the National Motor Boat Show in January than at any time in the past. The demand for seaworthy, efficient and economically operated small cruising craft has been steadily climbing. Today's small Diesel is providing a powerful impetus to its growth. It gives the one factor coming to be recognized beyond all argument – that of safety from needless fire hazards.



THE NEW AUBURN DIESEL AUTOMOBILE



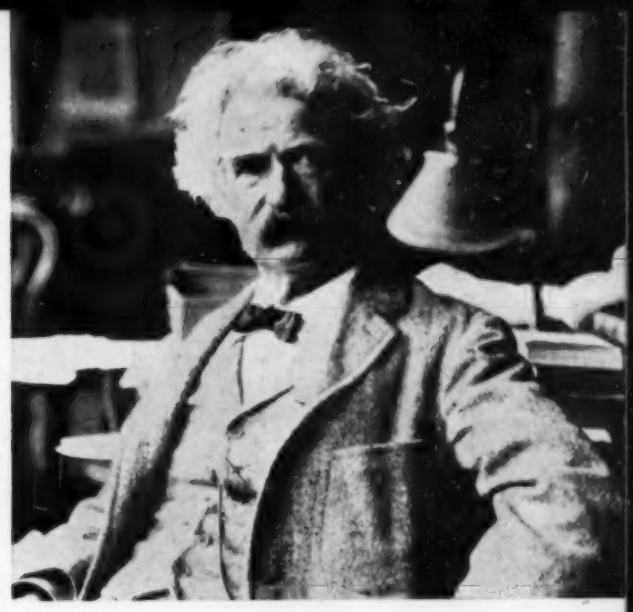
THE general public will shortly have an opportunity to purchase a Diesel automobile. The Auburn Automobile Company is putting through production a very limited number — for the present — of Diesel cars equipped with six cylinder Cummins Diesel engines of the type illustrated above.

It is stated that the chassis and bodies of the Diesel-powered Auburns are exact duplicates of the regular 1936 gasoline-powered models, the gasoline and Diesel engines being interchangeable. The same engine bed fits both.

It is to be assumed that the price of these Diesel automobiles will be comparatively high, because of the small number of both engines and cars now being built. However, if the demand for Diesel cars really exists in volume, then the price will logically fall as production ascends.

THE MARK TWAIN ZEPHYR

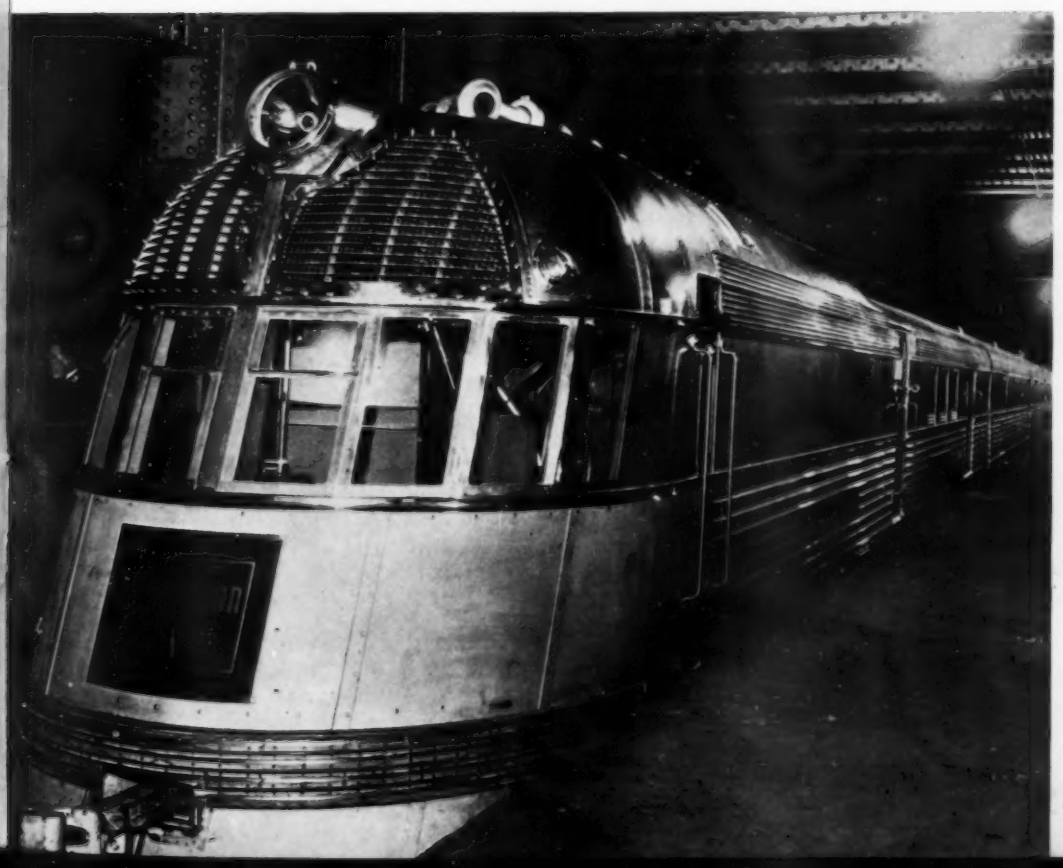
By REX W. WADMAN



THE onward march of Diesel progress is scored by still another event in the railroad world this month — the addition of a fourth member to that famous family of Zephyrs, the *Mark Twain Zephyr,* placed in service by the Chicago, Burlington & Quincy on October 28th. Its timely christening marks the 100th anniversary of the birth of another famed Missourian, America's beloved humorist, Samuel L. Clemens, better known as Mark Twain. The tracks over which this modern streamliner will run, from St. Louis to Burlington, Iowa, a distance of 221 miles, are laid along the same old levees where Mark Twain began his career as pilot of a Mississippi River steamboat. Its route lies through Hannibal, the romantic old-time river town where the celebrated author was born on November 30, 1835.

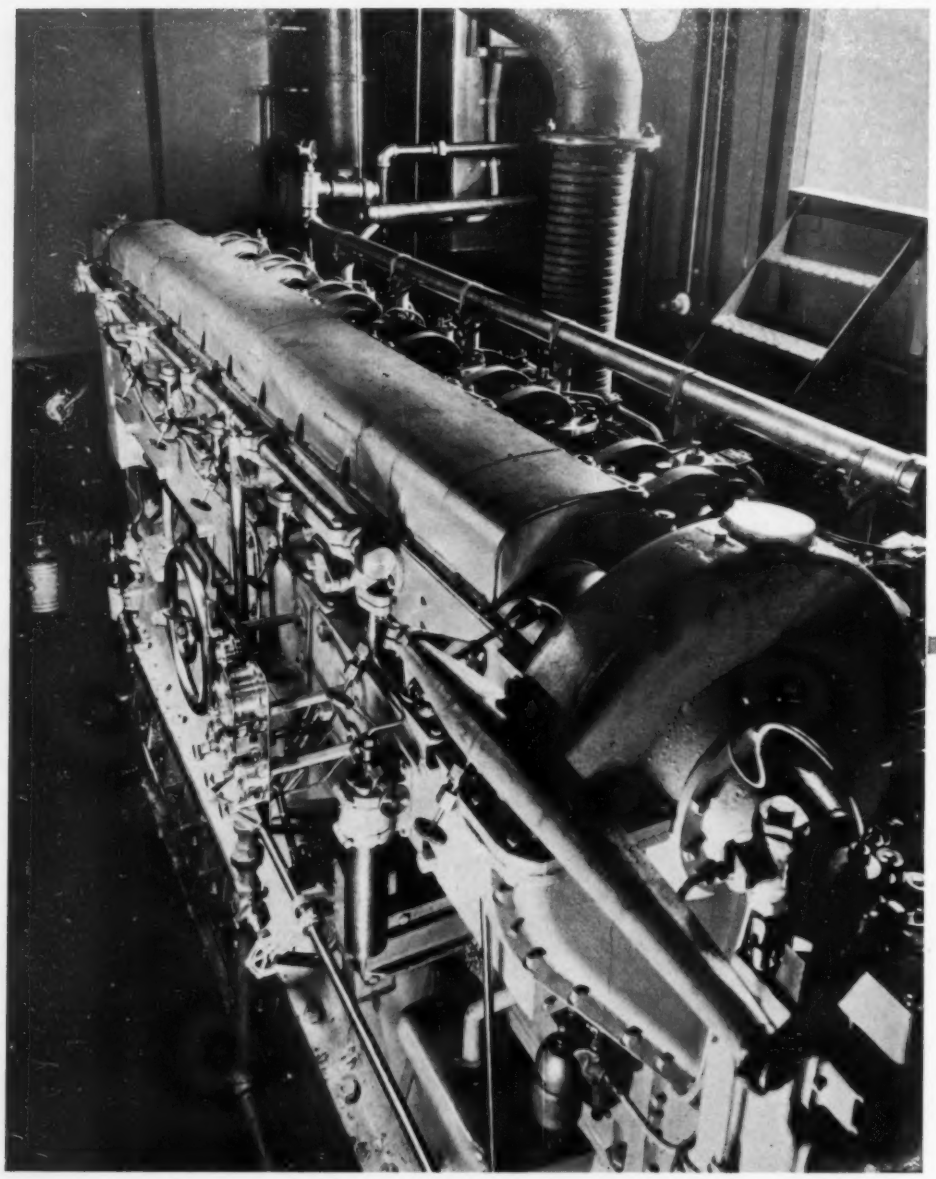
The *Mark Twain Zephyr,* a four-car assembly, 280 feet long, is propelled by electric energy generated by a Winton two-cycle, 8″ x 10″, eight-cylinder-in-line Diesel, rated at 600 hp. at 700 rpm. The main engine supplies power for all auxiliaries, including a 75-cubic-feet-per-minute air compressor driven mechanically directly from the rear end of the crank shaft of the engine. The electric equipment, including the main generator, exciter, auxiliary generator and traction motors, was built by the General Electric Company. The main generator is a single-bearing, differentially wound machine mounted ahead of the engine and directly connected through a flexible steel disk coupling.

The exciter is directly connected to the generator shaft, and an extension of the shaft drives the 35 kw. auxiliary generator mounted above the main generator through "V" belts. The two traction motors are mounted on the front trucks. The engine bed, fabricated by the Lukenweld process, is a rigid arc-welded structure, annealed after completion of the welding, and forms a combination bumper, engine bed and bolster. With a full load of fuel and water the entire train weighs only 287,245 pounds. The train was built by the Budd Manufacturing Company. Many new features that eliminate all sidesway when rounding curves at high speed, as well as insuring added comfort and conveniences to passengers have been added to the *Mark Twain Zephyr.*



Consisting of four articulated units, the first contains in addition to the driver's cab and Diesel-electric power plant with auxiliaries, a railway post office and storage mail room. The second is a combination baggage and express car. The third, containing kitchen and pantry, has a 16-passenger dinette and a 20-passenger compartment. The fourth car has a 40-passenger compartment and a parlor lounge seating 16 passengers. Appropriately, the four cars of the train bear the name of Mark Twain's best known characters, Tom Sawyer, Huckleberry Finn, Becky Thatcher and Injun Joe.

With fifteen regular stops and nine flag stops, the train makes the 221-mile run in five hours and forty-five minutes each way. What Mark Twain would say today if he could see this Diesel driven streamlined speedster flashing past the scenes of his boyhood is hard to imagine. Yet, by contrast with the trains of Yesteryear, it brings to mind one of his famous anecdotes — the time he advised the conductor to put the cowcatcher on the other end of the train, "because," as he said, "we are not going to overtake any cows, but there is protection against their climbing aboard at the other end and biting the passengers."



Close-up view of 350 h. p. Winton-Diesel engine in the towboat George Levingston

WINTON-DIE

Symbol of Economy and Dependability

ON-DIESEL POWERED

George Levingston PLACED IN 24 HOUR SERVICE

THE George *Levingston*, owned by Wm. T. Burton of Sulphur, La., and built by Levingston Ship Building Company, is giving continuous twenty-four hour service towing oil in inland waterways. This new boat, operating principally out of the port of Lake Charles, is one of the most powerful units of its type now in service in Louisiana waters. Its length is 65 feet, 9 inches; beam, 17 feet, 5 inches; draft, loaded, 8 feet, 6 inches; depth of hull, 8 feet, 5 inches. This boat, named for Mr. George M. Levingston, for years prominent in shipbuilding circles, is built for heavy-duty service and has a full model sea-going hull, designed for use in both shallow and deep water. The George *Levingston* is powered with a six cylinder, 12½" x 16" Winton-Diesel engine developing 350 h.p. at 300 r.p.m. . . . a power installation that is proving highly satisfactory in both continuous performance efficiency and reduced maintenance costs. Fleet operators everywhere recognize the outstanding superiority of Winton-Diesel engines for workboat application. To those who anticipate new or replacement power installations, we suggest careful investigation of the outstanding engineering features embodied in new advanced-type Winton-Diesel power plants.

WINTON ENGINE CORPORATION

CLEVELAND, OHIO, U. S. A.

One of a pair of 300 hp. Waukesha Hesselman oil engines, operated in parallel which drive two Allis-Chalmers 150 kw. d.c. generators.

OIL FIELD DRILLING

IN so-called "wildcat" territories where no electric power lines are available, water for steam engines is scarce and coal must be hauled, internal combustion engines are widely used for the power requirements for rotary drilling in oil field service. Where 400-600 hp. are being consumed continuously 24 hours a day it is only natural that the low operating cost of oil engines makes them the driller's friend and the answer to a real need.

Since one of the main problems in rotary drilling is to provide great pulling power at low speeds oil-electric rigs have become important factors in this field for lifting the string of pipe out of the hole. With direct current it is possible to obtain maximum flexibility for all operations as the full torque may be applied on the drawworks at zero speed of the driving motor with automatic increase of the hoisting speed as the "string" shortens and the load drops. In a similar way, the pump motors slow down with excessive pump loads.

A general view of the power plant. At the end of the shaft in the background is shown the 25 kw. oil-engine-driven exciter unit.

In the Mid-Continent fields several such "oil-electric" drilling rigs are being successfully operated. The design illustrated here is owned and operated by Loffland Bros., Tulsa, Oklahoma, and involves the use of two 300 hp. 900 rpm., Waukesha Hesselman oil engines which drive two Allis-Chalmers 150 kw., d.c. generators mounted on a common shaft. The engines are operated in parallel and drive each end of this shaft by means of a Texrope and sheaves. For auxiliary power, generator excitation, rig lighting, and to furnish starting current for the large engines, a small generator set is driven by a four cylinder Waukesha Hesselman oil engine. The drawworks rotary table and slush pumps are equipped with d.c. electric motors. For speed control of these motors the Ward Leonard variable voltage system is used. The speed of the separately excited d.c. driving motors is varied by controlling the voltage applied to the armature.

With two engines operating in parallel, it is possible, in case one engine is shut down, to handle maximum loads at half the normal speed. This is an important advantage as it is essential to be able to raise the drill stem off the bottom at all times in order to prevent its "freezing" in the hole. Another interesting feature is the way the engine cooling water is handled. The radiators are set away from the engines, and the fans are driven by small d.c. motors. These are thermostatically controlled and the fans only move air through the radiators when the jacket water rises above a predetermined limit.

HARRISONVILLE, MO.

THE folks who run the municipal light and water department of the City of Harrisonville may be from Missouri, but they don't have to be shown when it comes to the advantages of using Diesels. No sir! Here's what the president of Harrisonville's Board of Public Works, J. F. Atkinson, has to say on that score:

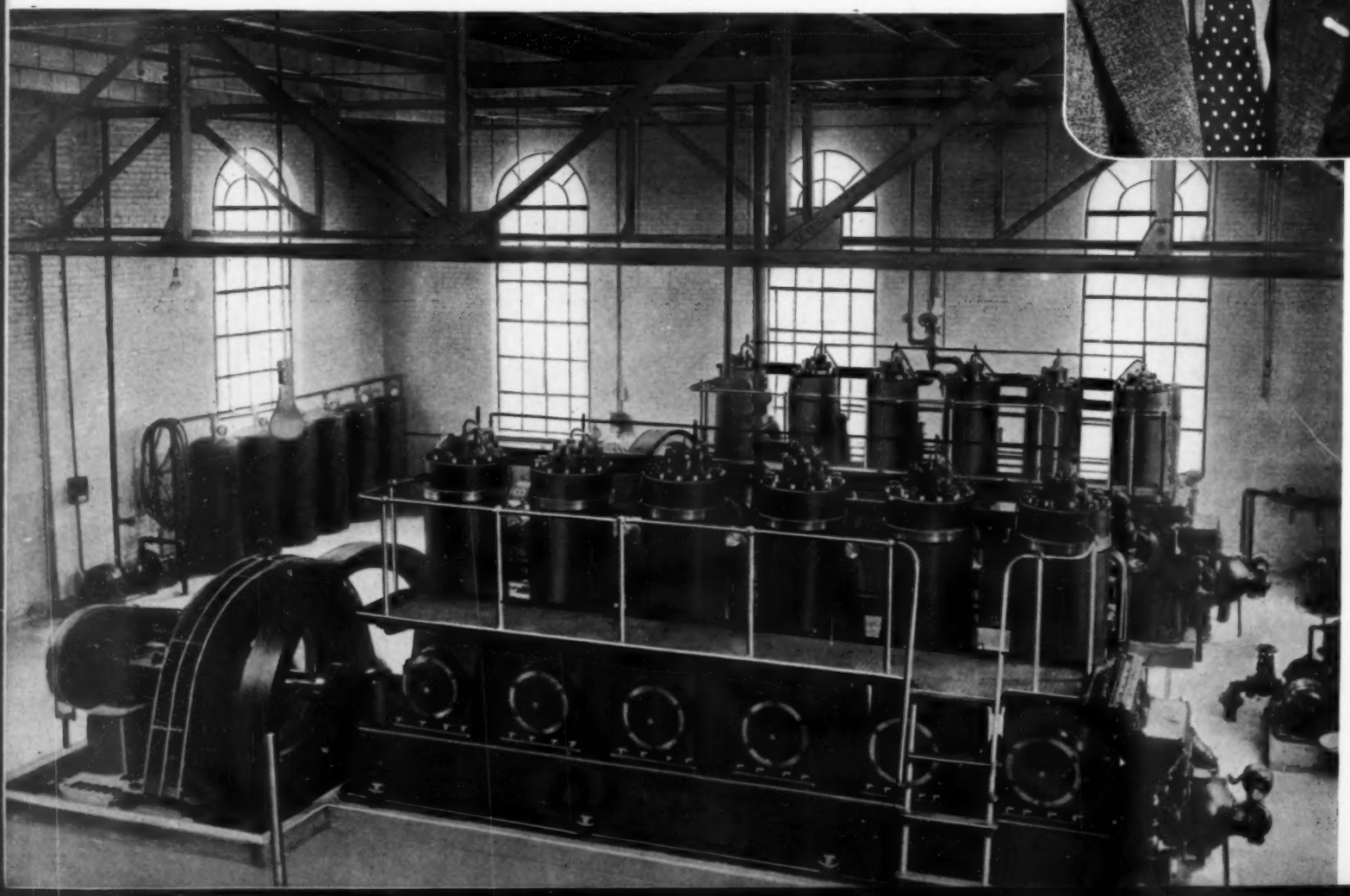
"Diesels? Why there's no mystery about them. Diesels, common sense and judgment, in our opinion, are sufficient to make a success of any power project." Mark Twain, himself, that illustrious Missourian, couldn't have said anything more to the point.

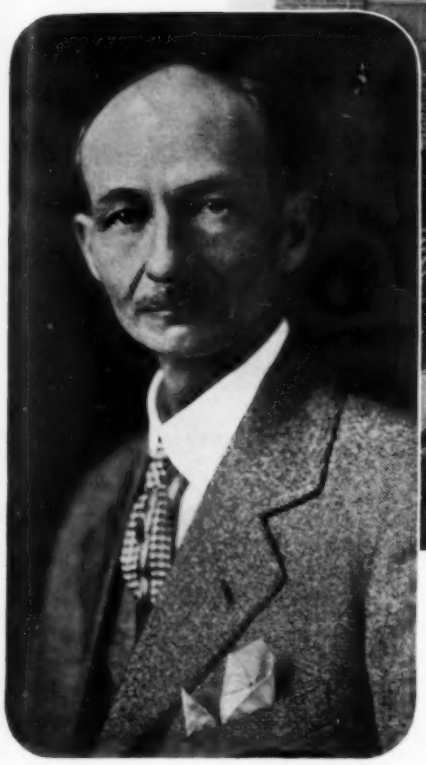
There's going to be a big bonfire this month in Harrisonville. Yes, they're going to burn the last obligations on the engines. They'll be all paid for. But that's getting a little ahead of our story. Let's go back to the beginning.

Harrisonville built its municipal plant originally back in 1900. Until 1918 it was operated with steam "with more or less success," as Mr. Atkinson put it, but finally with less success. Depreciation of its equipment saw the plant steadily losing money year by year and then came a change. The plant was leased to the local power company for a period of ten years. But it was a case of jumping right out of the frying pan into the fire.

It was the old story all over again. Rates began to increase. Interruptions of service were frequent. Nobody was satisfied. Things were even worse than before.

J. F. Atkinson, President of the Board of Public Works.





Lee Spicer, Mayor of Harrisonville.

But you can't beat these Missouri folks. They're resourceful. They had a card up their sleeve and now they saw their chance to play it. A progressive mayor and a group of public-spirited citizens put before the voters of Harrisonville a plan for a municipal light and water department to be operated with Diesels. Under their sponsorship the plan rapidly took form. In November, 1928, a bond issue of $100,000 was voted for a new, up to date water system and treating plant and at the same time it was decided to purchase and install two 360 hp. Fairbanks-Morse Diesels, with generators, switchboard, fuel tanks, cooling tower and all other necessary equipment at a cost of $62,150 plus interest, to be paid for out of the plant's earnings in 59 monthly installments.

Then when all seemed ready for operation and the folks of Harrisonville were rejoicing over their community's accomplishment, the power company, which had been keeping one eye glued to the keyhole, scored a royal flush by instituting court action to nullify the city's contract of purchase with the engine company on the alleged grounds that it was void and illegal. By taking advantage of several technicalities the power company and its lawyers succeeded in getting an injunction against the people of Harrisonville and their Board of Public Works to enjoin them from operating the plant and compelling them to pay the engine company a rental of $600 a month pending a decision of the state supreme court. Finally, after about 18 months of futile litigation a new contract was drawn up with the engine manufacturers by the city, and Harrisonville won the game.

On March 1, 1930, Harrisonville's new municipal plant began to function, giving its citizens for the first time a sample of public service that meant something. The Board of Public Works then started making payments on the engines, the engine company allowing the city a substantial portion of the rental which the power company's lawyers forced the city to make, to apply toward final settlement.

Harrisonville's plant consists of the two aforementioned 360 hp. Fairbanks-Morse Diesels, which are each six cylinders, 14" x 17", and each direct connected to 300 kva., 2,400-volt, three-phase, 60-cycle, Fairbanks-Morse alternators with two 10 kw., 125-volt, shunt wound, chain driven exciters. These engines are equipped with motor-controlled governors, motor-driven centrifugal circulating pumps, heat exchangers and water-washed exhaust silencers of the same make as the engines.

Harrisonville's gross receipts from March 1, 1930 to January 1 of this year were $166,607.10. Out of the net receipts of $91,073.36 the sum of $59,150, including interest charges, was paid on the engines and the balance turned over to the general fund. Operating expenses amounted to $75,623.74. It should be explained here that Harrisonville lists its street lighting and its water service as "free" items. For this same service the power company quoted $7,000 a year as its lowest rate, according to President J. F. Atkinson.

Out of the plant's earnings all the lighting system's distributing lines were rebuilt and several miles of new lines added. Since the start of its operations there has been in that period only one forty-minute shutdown and a

Cleo E. Brown, Chief of Light and Water Production.

total of only ninety minutes of divisional cut-offs, due to lines being blown down by storms. This is a pretty good record for any plant.

Harrisonville's light rates, as one would assume, are less than those formerly charged by the power company. A further reduction is expected to be made very soon now.

Harrisonville's Board of Public Works operates in accordance with the Missouri state laws and is composed of four members, two from each major political party, who serve during a period of five years. Each year one new member is added to fill the place of another whose term expires. Three members of the present board, J. F. Atkinson, its president; V. J. Willett, vice president; and H. S. Volle, secretary, have held office since their original appointment in 1928. The other member of the board is W. C. Deacon.

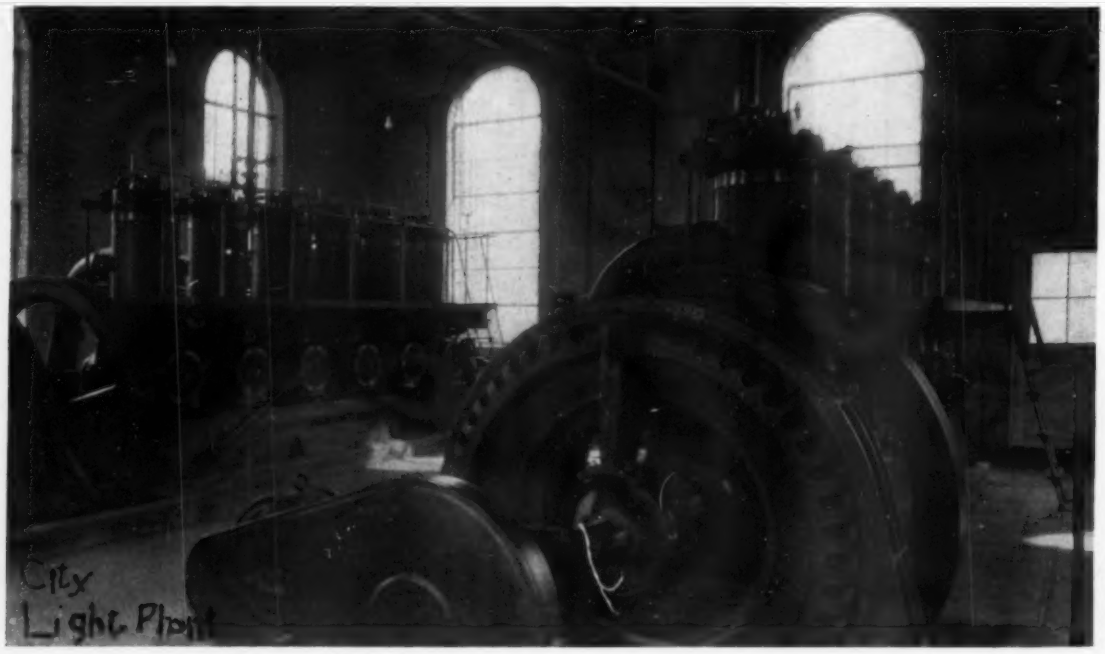
Harrisonville's figures for the five-year period it has been operating its municipally owned lighting and water plant are in the table below. Note that the 1934 production cost is based on complete maintenance, whereas the previous years do not include this item.

For the first nine months of 1935 the figures show a still more favorable operating schedule. With a slight increase in the cost of fuel from .0375, the average for the year 1934, to .0384 for the current year, the cost per kwhr. remains the same, the number of kilowatt hours per gallon of fuel rising from 10.25 to 10.52.

A large part of the credit for this performance goes to Cleo E. Brown, superintendent of the plant, for developing increased fuel efficiency of the engines. Despite a rise in the market price of fuel, Harrisonville's plant was able to show, all through the above period, a steady lowering of net fuel cost per kwhr. in proportion to the number of kwhrs. produced because of the increased kilowatt hours the engines were getting out of a gallon of fuel.

Mayor Lee Spicer isn't at all hesitant in giving credit to Diesels for his city's accomplishment. Far from it. He comes right out and says so. Here are the reasons he ascribes to the plant's success: "First, Diesel-generated power. Second, civic pride as exemplified by the various boards of public works entrusted with its management and the hearty cooperation of Harrisonville's citizens."

	1930	1931	1932	1933	1934
Average Cost of Fuel	.0387	.0294	.031	.0323	.0375
Total Kwhrs. Produced	734,200	962,000	977,100	914,300	1,062,800
Average Cost per Kwhr. at Switchboard	.0097	.008	.0082	.0086	.0085
Kwhrs. per Gal. of Fuel	8.32	8.60	9.09	9.30	10.25



Interior of the Harrisonville Municipal Light and Water plant, showing the two 360 hp. Fairbanks-Morse Diesel engines.

THE United Motor Transport of Sacramento, California, owned four gasoline-engined trucks, hauling gold concentrates from the Big Canyon Mine near Shingle Springs to the dock at Stockton, a distance of ninety-odd miles. According to Oscar Schneider and his brother, joint partners, "they were losing the company plenty of money."

Then they bought a Diesel. The picture at the right shows it hiking right along up a tough five-mile grade after pulling out of the mine, and the one beneath shows it dumping its load of concentrate assaying about $120 to the ton, worth $2,400 a load, on the dock for water shipment to Tacoma, Washington.

It is a Marmon-Herrington four-wheel drive, powered with a Hercules Diesel, and operates at a cost of ⅞ of a cent a mile. Since it started work last May it had gone 75,000 miles up to the first of October without touching even a wrench to the engine. It is on the move 24 hours a day, Sundays and holidays included. A spare Hercules Diesel purchased at the same time has stood uncrated on the shop floor for three months. Now it will be installed in another truck, replacing its gasoline engine. "No road failures, valve or ignition troubles for us now," say the Schneider brothers, "and we make better time on the road, too."

"THAR'S GOLD IN THEM HILLS!"

By F. HAL HIGGINS

John Hannon of Winsted, Conn. (extreme right) with his plant engineer, Edward Goewey, and two of his delivery men.

DIESELS AND ICE PROFITS

JOHN HANNON of Winsted, Conn., is one of those men who do not believe in being in a business unless they can make money in it. Mr. Hannon has been in the ice business since 1895. While his business is not a large one, when compared to some companies, it nevertheless is a profitable one – since he has been using Diesels.

Back forty years ago when John Hannon started in the ice business and when there were no electric refrigerators or bitter price wars, one ice dealer could produce ice just as cheaply as the next one. All he needed was an ice-house, a team of strong horses, a few men and weather cold enough to freeze the ice on the lake to ten or twelve inches. Today it's different. Natural ice is no longer the mainstay of the ice industry—even in New England. Mild winters now and then make the harvest an uncertain quantity. Last winter Mr. Hannon cut only ten per cent of his annual needs from Highland Lake. The rest he made in his plant. His plant, however, runs on no set schedule, but is operated strictly according to his requirements, which by experience he is able to reckon fairly accurately in advance.

The plant comprises a three-cylinder Atlas Imperial Diesel engine rated at 80 hp. at 360 rpm.

direct connected to a York 8″ x 8″ ammonia compressor, with a "Vee" belt-driven Electric Machinery Company 15 kw. a.c. generator which furnishes current to operate blowers, agitators, an overhead crane in the tank room, lights, and a 3 hp. motor which pumps water from the lake at the rate of 200 gallons a minute. This water is used for cooling the ammonia condenser, compressor, and engine. City water, first filtered, is used for making ice.

Three years ago when Mr. Hannon decided that manufacturing ice was the best way to insure an adequate supply the year round, he took two weeks off and drove around visiting other ice dealers in Connecticut and Rhode Island, who made their own ice, to see just what it cost them to manufacture it. In the course of his itinerary he went through several plants which were operating on purchased electric power. Inquiring about their costs he was told that power costs in those plants of twenty-ton capacity, in which he was interested, ran between $400 and $500 a month. "That was enough for me," declared Mr. Hannon. "I decided right then and there that I couldn't pay that much a month for electricity and figure a profit at the same time."

He had heard, of course, about Diesels in a general way, but it was not until he stopped at an ice plant in Rhode Island and saw the installation of an Atlas Diesel engine that he became actively interested in Diesel engines. He was surprised after comparing power costs per ton of ice with the Diesel against costs in the plants that were buying outside electric current. What impressed him most, however, was the appearance of the engine itself. To quote Mr. Hannon: "Its looks struck me and I liked it at once. It seemed to have lots of power and ran as smoothly as you would want.

"When the local power company found out I was thinking of putting in a Diesel," continued Mr. Hannon, "they came over to see me and tried in every way to discourage me from buying one. They quoted me a price of less than $1,500 for electrical machinery complete for making all my ice, as compared with $6,800, the cost of the Diesel and the plant machinery installed. They gave me all kinds of arguments, but what I found out from the owner of that Diesel plant in Rhode Island convinced me that Diesels were the best. I bought a Diesel and I haven't been sorry since.

"We use No. 3 fuel oil at six cents a gallon. I figure our fuel cost at 4.2 gallons a ton of ice, running on a 24-hour basis. Our lubricating oil consumption is about one-half gallon every 24 hours. This is at the rate of producing 22 tons of ice a day, during the summer. We just run it when we want to make ice. Last fall we shut the engine down for seven months and when we came to start it up this spring it started just as easy as if it had been shut down the day before, and it ran as perfect as you would want to see it."

"Our engine was installed July 8, 1933. It's been running two seasons now and all we've ever done to it is to have one spray valve out. It has given us the best of satisfaction, and so far we've never laid out a nickel for parts or repairs. The only current we purchase from the power company is a small quantity to operate the fan that keeps air circulating in the cans in the tank room when the engine is shut down."

Based on 4.2 gallons of fuel oil per ton at 6 cents a gallon, and two cents for lubricating oil, which includes periodical changes, the fuel cost per ton in the Hannon ice plant is 27.2 cents—very reasonable for a plant of normally 20 tons capacity and which operates only intermittently as the demand for ice varies.

In addition to supplying all his own needs, Mr. Hannon also sells ice to dealers in other nearby cities. But there are two things he doesn't do. He doesn't cut prices and he doesn't use power that would cost him so much that he couldn't make a fair profit. He uses Diesel generated power and is glad he made that choice.

The 20-ton Hannon ice plant. Right—
The 80-hp. Atlas Imperial Diesel engine.

Just a word about Precision Parts and Assemblies for Diesel Engines

IT IS A KNOWN FACT THAT PRECISION PARTS AND ASSEMBLIES ARE THE MOST IMPORTANT FACTORS OF THE DIESEL ENGINE.

You cannot expect to have a smooth and efficient running engine if you do not put into that engine, well-made and accurate-made Precision parts and assemblies. If you use such parts, it would be to your advantage to contact a leader in the manufacture of such items.

Marquette Metal Products Company is a known leader and has had considerable experience in the field of Precision parts and manufacture. We can assure users of quality and service.

We are leaders in the manufacture of

FUEL PUMPS
INJECTION VALVES
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The candid camera catches George W. Codrington, president, Winton Engine Corporation, on one of the few occasions he ever relaxes and vests — on a yachting trip.

George A. Rentschler, so much better known throughout the industry as Bud, president of the Hooven, Owens, Rentschler Co. One of the truly great young executives in industry today.

Austin Kuhns, whose modest title is executive engineer for Farrel-Birmingham Company, Inc., but who did such a grand job of selling in connection with the gear order on the Submarine contract.

NAVY DEPT. ORDERS PROPELLING UNITS FOR 6 NEW SUBMARINES

THE Navy Department, having placed contracts for submarines Nos. 182 to 187, two of them to be built at the Portsmouth, N. H., Navy Yard, one at the Mare Island Navy Yard in San Francisco and the remaining three at the Electric Boat Company's Groton, Conn., plant, placed contracts on September 28th for the propelling machinery.

The three men whose photographs are reproduced above, in conjunction with G. F. Elliott, President of the Elliott Company, constituted the four horsemen who came home with the bacon so-to-speak.

Diesel machinery equipment for three of these submarines went to the Winton Engine Corporation and the contract for the Diesel machinery for the other three vessels went to the firm of Hooven, Owens, Rentschler Company.

Contract for *all* the electrical equipment went to the Elliott Company, through their Ridgway, Pa., plant. Contract for the necessary reduction gears went to Farrel-Birmingham Co., and contract for the hydraulic couplings to Hydraulic Coupling Co.

Thus the Navy Department released contracts for machinery totaling between five and six million dollars to "heavy industry" plants urgently in need of such business to keep their employees profitably engaged throughout the coming winter and well into next year. Thus the Navy Department continues in its splendidly thought-out and worked-out plan of encouraging private industry to develop and perfect Diesel engines, electrical and other machinery, suitable for installation in submarines.

DIESEL COMPRESSORS

Top — With the Federal Government spending $400,000,000 on highway construction during 1935-1936, Diesel-driven compressors are much in demand. Here is a Worthington Caterpillar unit that makes money for Waugh Bros. of Culpepper, Va., engaged in rock drilling on the new Skyline Drive through Shenandoah National Park.

Right — This Chicago Pneumatic, driven by a 6-cylinder Hercules Diesel, has cut fuel costs over 70% and delivers 20% more air per gallon than the former gas-driven unit used by the owner, a prominent Pennsylvania construction firm. Attached to the Diesel is a midget 4-cyl. gas engine, connected through gears to the flywheel, used for starting.

The Caterpillar driven Schramm outfit shown below is one of two Diesel units used by Albert Bros., of Salem, Va., on their Sky Line highway contract. Here it is furnishing air to operate a drill sharpening machine. The Caterpillar engine is a six-cylinder, 5¼ x 8 Diesel. At 790 rpm. the outfit has an actual air delivery of 315 cu. ft. per minute.

A Buda Diesel operates the Schramm unit pictured above, owned by the Ralph E. Mills Co., of Frankfort, Ky. It has seen several years of service and was one of the first large Diesel powered outfits to be placed on the market. The job calls for removal of 140,000 cu. yds. of rock on this mountain road which, when completed, will join the Albany-Jamestown highway.

The grandaddy of them all — the largest portable air compressor ever built. It's a Schramm, water-cooled, single stage type, powered with a six-cylinder Buda Diesel of 720 cu. in. piston displacement. It delivers 504 cu. ft. of air a minute at 100 lbs. pressure and is used by the Robbins Dry Dock & Repair Co. of Brooklyn. By eliminating several smaller outfits it saves considerable fuel.

Cold weather doesn't make any difference to a Diesel. The unit at the left is a Sullivan compressor powered with a Caterpillar Diesel, used on a road job in Cottonwood Canyon, Utah. Floyd S. Whiting, Kaysville, Utah, contractor, is highly pleased with its performance.

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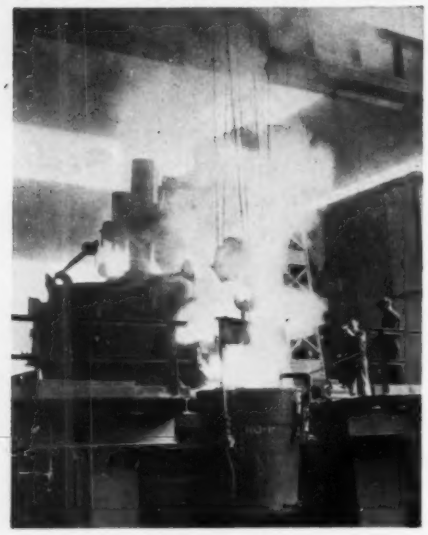

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RE-POWERING THE U. S. DREDGE *PULLEN*

. . . . *Continued from page 11* . . . .

the stationary housing removed, is illustrated in Figure 3. The impeller on the right is connected to the engine shaft, and the runner on the left is connected to the pump shaft. There is no mechanical connection between the impeller and the runner. A cover, known as the rotor housing, is bolted to the runner and encloses the back of the impeller to retain the working fluid.

With the coupling full and the impeller rotating, the oil in the passages between the vanes of the impeller flows radially outward under centrifugal force. It crosses the gap separating the impeller from the runner and flows radially inward between the vanes of the runner until it reaches the inner radius of the working circuit. Here the oil recrosses the gap and the cycle is repeated.

Power is transmitted by the release of kinetic energy as the vortex ring of oil flows radially inward between the vanes of the runner, this kinetic energy being generated during the outward flow between the vanes of the impeller. The generation of kinetic energy is represented by the increase of rotational velocity about the axis of the coupling as the oil flows between the inner and outer profile radii of the impeller. Likewise the release of energy is represented by the decrease of rotational velocity as the oil flows inward in the runner.

The vortex, or circulatory flow, is relatively slow and is due only to the difference in centrifugal force resulting from the difference in speed between the two members of the coupling. As the torque input to the coupling is identical to the torque output, the loss of power is represented by the "slip," or difference in speed between the driving and driven shafts. The efficiency of the hydraulic coupling is, therefore, the ratio between the driven and driving shaft speeds.

To permit rapid clutching and de-clutching, a valve is installed in the oil supply line to the coupling and a series of ports or nozzles are provided in the periphery of the rotor housing. The ports are covered by a ring valve which is capable of a small amount of lateral movement so that when it is desired to de-clutch, the ports are uncovered and the oil in the coupling is thrown out under centrifugal pressure. The valve in the oil supply line and the claws for operating the ring valve are interconnected mechanically through a rocker shaft so that when the ring valve is in the closed

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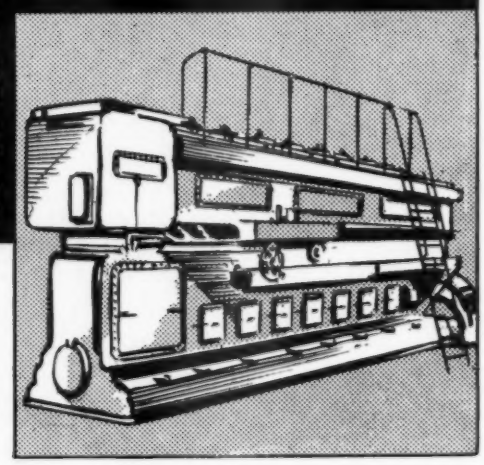

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position, the valve in the oil supply line is open. Likewise, when the ring valve is in the open position, the valve in the oil supply line is closed.

The rotating parts of the hydraulic coupling are completely enclosed by a stationary housing of welded steel construction. Leakage oil flows from this housing into a sump tank from where it is delivered by a small rotary type pump to a gravity tank located on an upper deck. A pipe connects the gravity tank with an opening in the side of the coupling housing so that a continuous circulation of oil is maintained. The sump tank is of sufficient capacity to permit storage of all the oil in the system when the engine and pump are not in operation.

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FIG. 1116 NC #0 | FIG. NO. 1116 NC #1R | FIG. NO. 1116 HA #4R | FIG. NO. 1116 HA #4S | FIG. NO. 1116 HA # 4L

Filtering Cap. G.P.H. 5 to 150	Filtering Cap. G.P.H. 122 to 285	Filtering Cap. G.P.H. 442 to 960	Filtering Cap. G P. H. 640 to 1,640	Filtering Cap. G.P.H. 720 to 1,920
Filt. Area 275 sq. in.	Filt. Area 513 sq. in.	Filtering Area 1,140 sq. in.	Filtering Area 2,280 sq. in.	Filt. Area 3,780 sq. in.
Space occupied 272 cu. in.	Space occupied 578 cu. in.	Space occupied 930 cu. in.	Space occupied 1,505 cu. in.	Space occupied 2,040 cu. in.
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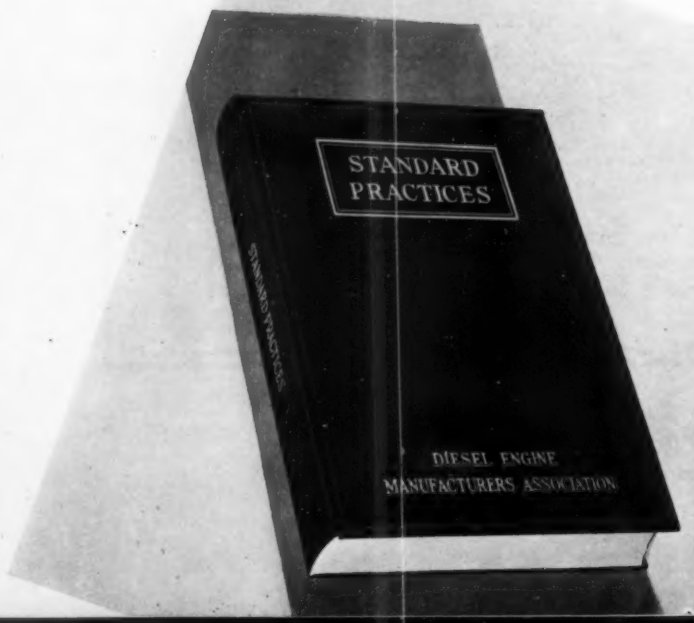

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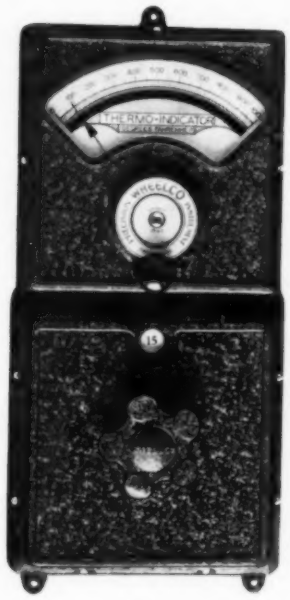

In a multiple-engine installation, with only one operator on duty, a device of this nature, which will automatically ring an alarm when either the exhaust temperature, water temperature or lubricating temperature passes a near-danger point, will earn its keep many times over.

In a single engine installation, where the operator gives but a part of his time to the engine, such an instrument will save many shut-downs and heavy repair bills – the ringing of an alarm will bring the operator to the engine and warn him of the point of danger, so that he can correct it before serious damage results.

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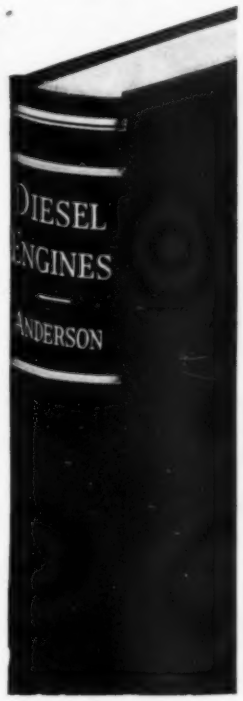

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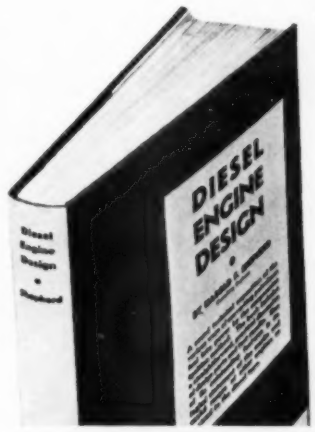

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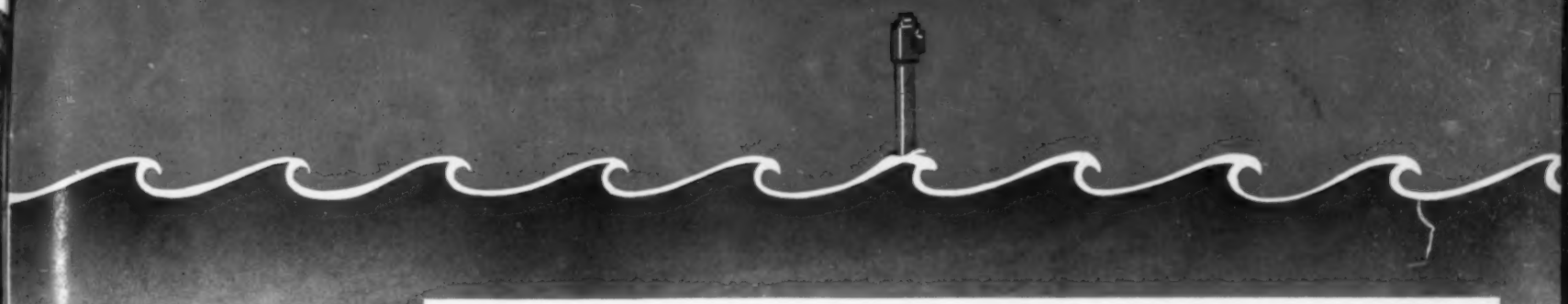

ELLIOTT COMPANY HAS AGAIN BEEN SELECTED to build the electrical equipment (generators, motors, gears and control) for another group of United States Navy Submarines.

This time the job includes the complete electrical machinery for the six new Submarines Nos. 182 to 187. The contract is in collaboration with the Winton Engine Corporation, Cleveland, and the Hooven, Owens, Rentschler Company, Hamilton, Ohio, each building the Diesel engines for three submarines.

Including this contract, the Elliott Company will have furnished the electrical equipment for 12 of the last 16 submarines let under the new submarine building program covering the past two years. For many years, Elliott Company and its predecessor in the electrical machinery business, The Ridgway Dynamo and Engine Company, have furnished electrical machinery for U. S. Submarines.

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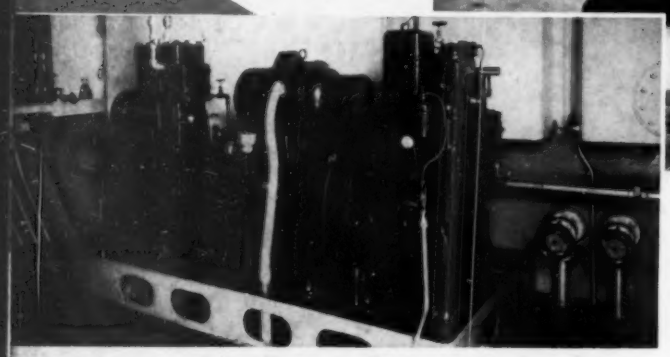
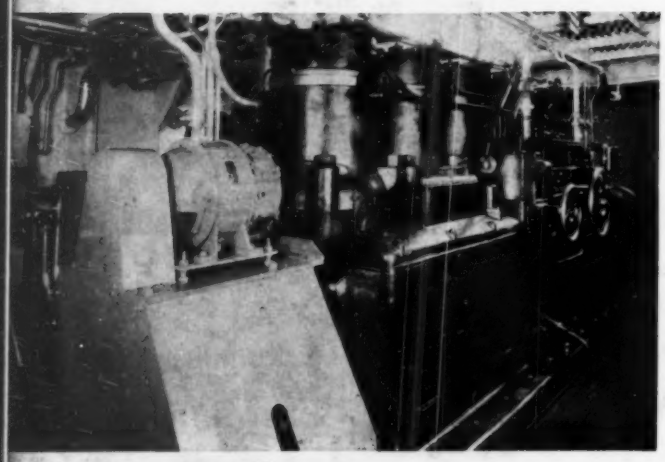


Combination auxiliary set including air compressor, 75 g.p.m. pump and 2¾ kw. generator, all driven by a 10-hp. Model 36-A Diesel.

Engine room of the "Chippewa." Main control station at right is also connected to operating station on main deck, from which engineer can watch the vessel's movements and control his engines from this more convenient point. Generator shown at the left mounted on forward end of engine charges batteries while main engine is in operation.



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